ERRATA.

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Page 18, line 21, read *situations*
—— 27, line 4, for confirms, read *conforms*
—— 28, line 4, read *so* we are forced
—— 29, line 16, for vaporus, read *vapours*
—— 127, line 1, for water, read *waters*
—— 144, line 20, for call, read *called*
—— 175, line 20, read *animalcula*
—— 191, line 14, read *Phlegræi*
—— 204, line 1, read αχμη
—— 261, line 9, read θιοθιν
—— 278, line 17, read πρωτιστα
—— 304, line 13, read αρχη
—— 312, line 12, read *between*
—— 392, line 20, for reception, read *perception*
—— 408, line 20, for axis, read *axes*
—— 431, line 13, read χατα
—— 443, line 2, read Πλατων

A

VIEW OF NATURE,

IN LETTERS

TO A TRAVELLER AMONG THE ALPS.

WITH

REFLECTIONS

ON

ATHEISTICAL PHILOSOPHY,

NOW EXEMPLIFIED IN

FRANCE.

By RICHARD JOSEPH SULIVAN, Esq.
F. R. S. AND F. A. S.

Mala enim, et impia consuetudo est contra Deos disputandi, sive ex animo id fit, sive simulate.

CICERO.

IN SIX VOLUMES.

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MVSEVM
BRITAN
NICVM

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LETTERS
TO A
TRAVELLER
AMONG THE ALPS.

LETTER XXXII.

THE philosopher who turns his mind to the contemplation of the general system of nature, too frequently fancies a quickness and impetus of operation, which probably bear no more analogy to the thing itself, than the energy of his own feeble powers do, to the all actuating universal cause. Nature is slow in her operations. She proceeds by insensible gradations. Man, on the contrary, would be as momentary as his thoughts. Ages, probably, are necessary to the consolidation of metals; ages we can readily believe, to be required for the formation of precious stones. But, these are all imitated by art,

and are even brought to a certain degree of perfection, in very inconsiderable spaces of time. This makes us assuming: But look into yon sparry cavern in the mountain; remark that grotesque indurated mass; it is the growth of a period so unlimited, as to afford us no room even for conjecture, as to the æra of its origin: and yet, in the chymist's laboratory, he could produce you a stone, for the formation of which, a few hours would be more than sufficient. Let us not, however, argue hence, that nature proceeds in the manner we do: it is too great a degree of rashness, to assume the extent of the power of the artist, as a limit for that of the Creator; and to imagine, that the state of our acquisitions, is the state of absolute information. With sure, but gentle pace, nature pursues her ends. She composes and decomposes with measured step. We may think ourselves possessed of her secrets: the difference, however, may be as great, as eternity is to a moment, or as an atom is to a world.

In no instance is this reflection more applicable, than in the supposed formation of the very mountains and vallies, which we have now under consideration. The corresponding angles of hills, (convex ones being supposed to be constantly

stantly opposite to concave ones, or when one exhibits a cape or a salient angle, the other is to present a bay or an obtuse one) was an opinion, which led M. Bourguet, and after him, many other respectable men into the error, that vallies had been dug out by rivers and torrents, either when the waters retired from the earth, or subsequent to that period. But the truth is, that the great longitudinal vallies of the Alps, whose existence is as ancient as that of the mountains, frequently present the most contradictory prominencies and contractions, and are closed almost universally at one, if not at both ends. At the same time, however, it must be confessed, that hills are not unfrequently steep and precipitated on one side, and gently declining on the other; as if the action and direction of the motion of the waters, had been greater on the one side than on the other. But, in order to find a key to the theory of the earth, as relative to the currents of the ancient ocean, in which the mountains have been formed, it must be sought for in the direction of the beds of mountains, and in their varieties: moreover, the compositions of the sides of the very same mountain, are frequently so different, that from the summit to the bottom on the one side, there shall be nothing but calcareous rock, while on

the other, it shall be a confused jumble of stones of every denomination.*

It has also been asserted, that when we see the same strata in the opposed sides of different mountains, we should infer, that the matter of these strata were once continuous. The same inference should be made, it is also said, when we see the chalky clifts as of Dover, on the one side, corresponding with those of Calais on the other; Justin says, "Siciliam ferunt "angustis quondam faucibus Italiæ adhæsisse, "direptamque velut a corpore majore impetu "superi mari, quod toto undarum onere illuc "vehitur." Many strata, indeed, have been indisputably continued, which are now no longer so, but whose intermediate parts have been removed by violence or other causes: but, at the same time, that this may be admitted, that mountains are natural productions in the ocean, it is not at the same time to be argued, that vallies are adventitious ones out of the ocean.

In the course of his voyages, the very able Captain Cooke thought he had reason to be of opinion, that some of the islands discovered in the

* De Saussure.

the Pacific Ocean, were formed by the slow growth of coral rock, and the gradual accession of sand and shells. They were observed in every state of their progress; some, which were arrived at their highest maturity, and were covered with vegetables, had only a very thin layer of mould, immediately under which the coral rock appeared in every part of them. Others were but just risen above the level of the sea, some of which had very few, and others no vegetables at all. On one of these, called *Palmerston's Island*, a few cocoa-nut trees and other plants were just seen sprouting up, a few inches above where the sea had reached; and on others, the various plants, which grew nearest to the shore, were in lines parallel to it, and evidently arose from seeds brought thither by the sea.

From this, a deduction I think is warrantably to be drawn; that if the waters were, by any means, to be separated from these islands in the southern hemisphere, the islands would then become mountains, and their vallies would be found to have been naturally formed in the bosom of the same ocean, and at the very same period of time. It may be urged, indeed, on the other side, that in the highest parts of the vallies, surrounded by the highest Alps, one

does not meet with rounded flints. They are strangers, it is said, to those parts; whereas, in the plains, and in the entrances of these vallies, and even on the tops of mountains which surrounds these plains, such quantities of them are found, that an unenlightened man would suppose they had tumbled from Heaven. * Now it is a fact, that these flints are of a nature totally different from the stones which are found to be in their neighbourhood. What can they be else then, (it is asked) but the wrecks of other parts? To this I will not answer, as others have done, that rounded flints do not receive their forms by attrition only, but, that they have been rounded in their original structure in the beds of matter, from which the waters, or, revolutions of the earth, have at some distant period separated them: nor will I say, that they were originally created in nodular forms, attrition by water probably injuring their surface; but, certainly, not being the cause of their forms. The flints which are so universally picked up in the Alps, I can readily conceive to have been detached from mountains very distant from them, and that they have been smoothed and rounded by the waters. Naturalists who travel over high mountains, or where rivers

* De Saussure.

rivers take their source, clearly perceive how stones naturally angular, lose their angles; and as it were under their eye, assume a roundness. The shores of the sea and lakes shew, likewise, the same transformation by the power of the waves; as the lava of Ætna does, which rushes into the sea. Granite, marble, jasper, &c. which are the substances of most flints that are rounded, looked at in the spot which produce them, are never found rounded. The beds on which flints are generally deposited are calcareous, and consequently of an apparently different nature; nay, it is evident, that they have no adherence to the soil on which they are thrown, and that they have no resemblance to the earth which surrounds them. Moreover, there is nothing but water, which in diminishing their weight, could have laid them with the lightness with which they have all evidently been deposited. Had they rushed through the air upon a volcanic hypothesis, and to have fallen only eight or ten feet, they would have been buried to a considerable depth.

My argument goes not so far, as to deny the power of the waters in their retreat; on the contrary, I warmly contend for it: I only mean

to say, that there does not appear a necessity why the vallies should not have been formed when the mountains were; nor a very philosophical reason, why the waters in their subsiding from the surface of the earth, should have had force sufficient to have excavated piles of granite of an enormous height, and that in a space of time, too scanty even for the formation of the channel of a brook: and these difficulties are moreover strengthened, by the confession of naturalists themselves, who allow, that the bottom of many of these vallies is of the primordial granite itself, while many of the smaller sized incumbrances with which they are loaded, are secondary or calcareous.

These mountains and vallies of granite, therefore, we must conclude, were formed at the same period, and by the same cause. The waters were the medium, whence the component particles were derived, and crystallization effected the mighty work; but, all this reasoning, you will say, has been denied; fire, you will say, has been the powerful agent, on which some of the ablest philosophers have wished to rest their system of mountains. On this subject, we will not argue at present: I will not concede the ground; and yet, it would be ridiculous to deny the

the element of fire, the share to which it is entitled. One word may suffice for the present; the element of fire, I must hold to be incapable of throwing up such prodigious mountains, as we have upon the face of the globe: For, let us figure to ourselves the operation which could raise the Alps. * I do not speak here of their weight; I admit, for argument sake, a force sufficient to surmount it: But, does that same force still rest with them, to keep them in suspension? After the strong exertion of the elastic fluid, the earth being thrown up, would occasion many fissures; through these fissures, the elastic fluid would escape, thus consequently, the raising force would be destroyed; nothing but the specific weight would remain, and the mountains not having frames made for their reception, would inevitably fall into their primitive state. I, at least, cannot see the matter in any other light: moreover, the formation of *Il Monte Nuovo*, which is always quoted as an instance, was gradual, and was formed merely of accumulations round its cone; the same has happened, it must be confessed also, in the formation of many islands, of which we have an account; they have evidently been gradual. But this has not been the case with granite, with pri-

* De Luc.

primordial mountains or islands; neither can it be admitted even to the secondary or calcareous mountains; more of this, however, in its proper place: we shall here simply adjudge them, and you must not be displeased with me for my tenacity to the parent to whom they belong—to the ocean.

In the full belief of this opinion, you will conclude, it would be consistent in me to adhere to the doctrine, that the elevations of the earth are greatest at the Equator, especially as the centrifugal force during a fluid conformation of the mountains, might be supposed to have had a most unequivocal energy: but, as the desire of truth has already made me deviate from established and very favourite principles, I shall refrain from drawing, even to my own assistance, any thing that I shall not conceive to be well supported. Mountains are not more elevated at the Equator, than they are on other parts of the globe. The Andes commence many degrees to the southward of the Equator; for, running as it were from it, through Peru, Chili, and Magellan, they stop at the 55th degree of south latitude; whereas, on the isthmus of Panama, which is in the neighbourhood of the Line, the mountains are comparatively very low. The highest

highest mountains of Asia are greatly beyond the tropics. They commence in Africa, towards the 30th degree of north latitude, and traverse all Africa and Asia, between the 38th and 40th degrees. The Pics of Spitzbergen, of New Zealand, of the Alps, the Pyrenees, &c. and almost all of which are eternally covered with snow, are distant from the Equator. How then can I support; or rather, how would it be applicable to my present reasoning, to avail myself of the doctrine of the centrifugal force? But, though the equatorial elevations are not greater than those of others, which approach even to the neighbourhood of the Poles, it yet is in general to be observed, that the greatest eminences of this globe, are situated from north to south; * and it is by this disposition, that almost all the points and terminations of continents are north and south: at least, thus, they are said to be in the southern hemisphere, and in those parts, are the greatest inequalities, perhaps, we are acquainted with.

* Buffon.

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LETTER XXXIII.

IT is recorded, that the *Zuiderzee*, whence the vessels of Holland enter the ocean, was in the time of William II. King of the Romans and Count of Holland, covered with the most luxuriant pasturage. Among various other proprietors, Hotman Galama, a gentleman of Friezland, had some estates there: walking out one morning, he perceived a herring in a ditch, which had no apparent communication with the sea. He long puzzled himself to discover how it could have got there. At length it struck him, that his land must have been undermined by the sea; terrified at the idea, but, without saying a word of his suspicion, he disposed of his estates as speedily as possible, and purchased others at a considerable distance. The measure was to him, both a wise and a lucky one: his lands, in a short time afterwards, were irremediably overwhelmed by the ocean, and vessels in a few months cast anchor, where heretofore there had been flocks of sheep.

Thus

Thus high and low, elevated, or depressed, each corner of the earth affords matter for contemplation; but no theatre is more instructive than the Alps: while you traverse the craggy sides of those tremendous mountains, which rise in dreadful majesty the further you ascend, whose venerable brows are charged with an eternal ice, but whose rugged recesses display scarcely any thing but devastation and frigid penury; how chill and tardy runs the blood; how eagerly we search—why such enormities were huddled together. "Les peuples," says Mr. Bourrit, "qui avoisinoient ces masses collossales, repoussès par leurs aspects terribles & menaçans, ne les contemploient qu'avec effroi, ne les regardoient que comme un mal dans la nature. Les orages qui s'y forment; les chûtes de rochers, celles des neiges qui renversent, bouleversent & détruisent tout sur leur passage; les débordemens des torrens des rivières étoient regardés comme les agens d'un esprit malfaisant, ou d'un Dieu en courroux." But from these terrific scenes, cast your eyes a little further, and how smiling and rich the prospect bursts upon your view; how exquisite the contrast. In the whole circle of our hemisphere, there is not, perhaps, a combination more wonderful, nor more instructive. In what scene, independent

dent of its sublimity, can we observe at the same time such diversity of seasons? Where could we so well seek for a spot, where, at a glance, we might embrace the winter of Siberia, and the summer verdure and luxuriancy of Italy? "Où l'homme peut-il n'avoir qu'à tourner la tête pour parcourir dans un clin-d'æil, toutes les horreurs de l'hiver & les richesses de l'Eté, quatre-vingt lieues de plaines fertiles, couvertes de villes, de vignobles, de champs, & de bestiaux; & vingt mille pieds de glaces encore plus voisines & qui forment l'horison de ces campagnes?. *

These striking, and in the wide extent of nature, perhaps unequalled features, yield to the imagination a pleasure, abundantly surpassing common things: for, not to confine ourselves merely to the contemplation of snow and ice, and the assurances they give of perpetuity to the rivers, of which they are the source; if we reflect on the formation of these mountains, on their age, their succession, on the causes which could accumulate rocky elements to so great an elevation; on the origin of these elements, and of the revolutions which each hath undergone, into what an abyss of thought are we plunged! with

* Bourrit.

with what admiration do we contemplate the mighty works of God!

It is with a feeling of this enthusiastic nature, that philosophic men in general are impressed, who ascend the Alps, where the air is pure and subtile, where they have more facility of respiration, and where they experience a lightness of body with a perfect serenity of mind. "Our meditations, in such situations," observes Rousseau, "partake of I know not what—of grandeur and sublimity; but, they are proportioned to the objects by which we are surrounded, and we enjoy them in voluptuous tranquillity. As we elevate ourselves above the abodes of men, it would seem we threw from our minds all low and terrestrial sentiments; and in proportion as we draw nearer to the etherial regions, we feel our souls contract some portion of their unalterable purity. The spectacle has in it something magical, and almost supernatural. It hurries away our judgment and our senses. The greater our ascent, the greater our emancipation from what we left below. From finite ideas, we dare to think of infinity; from extension, we reach forward to immensity; and from the momentary bustles of our little world, we pass to the immoveable stability of the universe."

But,

But, these Alps, considerable as their elevation may be, are not the parts of the globe which ascend highest into the atmosphere: for a long time, it was thought, the *Pic of Teneriffe* was the loftiest mountain in our hemisphere; but this was an error; *Mont Blanc*, we now know, exceeds Teneriffe, and not only Mont Blanc, but many other of the Alps of Savoy and Switzerland. Mont Blanc, as an integral elevation, and independent of any measurement from the level of the sea, might seem to be the highest mountain of the earth; but this does not accord with general and fair calculation. Chimboraço, though inferior in itself to Mont Blanc, is yet more elevated, from its base being very considerably higher above the level of the ocean. At the same time, that if Mont Blanc could be transported to the foot of Chimboraço, Chimboraço, all prodigious as it is supposed, would appear of very insignificant dimensions. The base of Chimboraço is upwards of ten thousand feet above the level of the sea. How great the difference between this and the base of Mont Blanc! but, at the same time, as mountains simply, Mont Blanc is half as high again as Chimboraço: the difference, however, between Mont Blanc and two other celebrated mountains, will strike you still more. The

ele-

vation of Ætna is 10,954 feet, and that of Vesuvius 3,900 feet; in all 14,854. Now Mont Blanc is 15,562 feet, or thereabouts, which makes it higher by 808 feet, than Vesuvius and Ætna, like Pelion and Ossa piled one upon the other.

Notwithstanding this superior elevation of the soil, though not of the mountains, of the Cordelliers, the air is found to be infinitely more fit for respiration on the Cordelliers, than the Alps, at the same elevation. This has occasioned some perplexity; particularly, as it had been calculated, that at a given number of feet of elevation, you receded as from the Equator a degree; and consequently, that at about half the height of Mont Blanc, you would be advanced to a cold equal to that of the 80th degree of latitude. The less rigid temperature was, indeed, attributed to the Cordelliers, from their being placed more in the neighbourhood of the Equator, and from their atmosphere being impregnated with heavier and grosser vapour. A physical reason, undoubtedly of some weight; for the fogs and dense air, which are there experienced, are proof and evidence sufficient, of the grossness of the vapor. But,

I apprehend, we must look to some other cause for this atmospheric difference.

Quito, the capital of Peru, is situated between two chains of the Cordelliers, about 40 leagues from the sea, and on an elevation of soil of about two-thirds of the height of Mont Blanc. The mountains lose their heads in the clouds, and are almost all covered with enormous masses of snow, as old as the summits on which they are spread. The valley in which Quito has been built, exceeds considerably the summit of the highest of the Pyrenees; and yet here, and in the same point of view, you will see blossoms and fruits, plowing, sowing, and gathering the plenteous harvest, as is even with astonishment observed in the teeming regions of the torrid zone. How are these phænomena to be accounted for? But, we will not anticipate; the discussion will soon come regularly before us. For the present, be it sufficient, that we are convinced of the matter of fact; that situation, which, with us would be as unproductive as the frozen deserts of Greenland, are yet in more happy circumstances, fertile, and luxuriantly productive.

Moun-

Mountains, among which we are now travelling with philosophic discrimination, are, in truth, the surest beacons we can trust to. They are old, but they are firm; they are clothed, indeed, in the wisdom of ages, but they are vigorous and universally instructive. How awfully the clouds roll down the sides of the eminences which surround you; how powerfully the winds rush; how frightfully the thunder roars! Whence the cause of such warfare? Are the elements, here one and all, to exhibit themselves in their sublimest form? Or, are similar strifes more common; but, is man less attentive to them in other situations? A momentary enquiry, will throw some light upon the subject. In the clouds, and in the regions above the clouds, we must search for the elucidation of these phænomena. Electricity presents itself before us, and that mighty agent we must investigate and trace, in its favourite etherial mansion.

The most wonderful discovery of modern times relative to the earth, has been electricity, which is a principal and constant agent in the works of nature; and extends its influence to all bodies without exception, whether mineral, vegetable, or animal. By its effects, contrary to

the principles of gravitation, we see bodies attracted, repelled, and held suspended by others, and through no other means than a slight friction; while another body, by the very same friction, shall reverse all its effects. We see a piece of cold metal, or even water or ice, emitting strong sparks of fire, so as to kindle many inflammable substances; and in vacuo, its light to resemble what it really is, lightning. Flashes of lightning are always crooked, so are flashes of electricity. Lightning strikes the highest and most pointed objects in its way, preferably to others, as high hills and trees, towers, spires, masts of ships, &c. In like manner, all pointed conductors receive or throw off the electric fluid, more readily than those which are terminated by flat surfaces. Lightning burns, so does electricity. Lightning dissolves metals, so does electricity. Lightning rends some bodies, so does electricity. Lightning destroys animal life, so does electricity. All the operations of electricity depend upon one fluid, *sui generis*, extremely subtile and elastic, dispersed through the pores of all bodies; by which the particles of it are as strongly attracted, as they are repelled by one another. It is, most probably, a real vapour ignited. It is highly visible in vacuo: One of the principal

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reasons, why flashes of lightning sometimes make a very long rumbling, is the vast length of the vacuum, made by the passage of the electric matter, although the air collapses the moment after it has passed; and the vibration (on which the sound depends) commences at the same moment, through the whole length of the tract.

This vacuum, Beccaria says, is very observable upon great explosions of thunder, when animals have been struck dead, without being touched by the lightning; a vacuum being only suddenly made near them, and the air immediately rushing out of their lungs to fill it, whereby they are left flaccid and empty; whereas, when persons are immediately killed by lightning, their lungs are found distended. Lightning may be considered in three states: The first, that in which it explodes and flashes, without any force to do harm; the second, when it explodes with greater force and density, striking people with blindness, setting fire to combustibles, &c.; and the third, the thunderbolt, which is a compact and undissolved body of ignited matter, which has not time to explode in the air, but is darted with the velocity

of light itself, striking objects with an inconceivable and irresistible force.

Beccaria establishes it, that great quantities of electric matter, at times rush out of particular parts of the earth, and rise through the air into the higher regions of the atmosphere. Attracting and carrying with them sand, ashes, and other like substances; together with the watery particles which are dispersed in the atmosphere, and that thus vapours are raised to cause storms. But, what can be more miraculous than to find, that a common glass phial or jar, shall after a little preparation, (which, however, leaves no visible effect, whereby it can be distinguished from other phials or jars) be capable of giving a person so violent a sensation, as nothing else in nature can give, and even of destroying animal life, and this shock attended with an explosion like thunder, and a flash like that of lightning? Even Newton himself would have wondered at this discovery.

The electric fluid, as I have already said, exists in all the bodies of the earth; and is repulsive of its own particles, but attractive of the particles of other matter. Thus, when a body does not shew any electrical appearance,

it

it is then supposed to contain its natural quantity of the electric fluid, and is then said to be in its non-electrified state: but, if it shews any electrical appearance, it is then said to be electrified. And hence a body having received an additional quantity of electric fluid, is said to be overcharged or positively electrified; and a body that has lost part of its natural quantity, is said to be undercharged, or negatively electrified.

From all experiments, says Priestley, it appears, that the electric matter either is, or contains phlogiston, since it does the very same thing that phlogiston does. It is also probable, that the sulphureous smell occasioned by electricity, being very different from that of fixed air, may be produced by the phlogiston in the electric matter itself. The substances capable of transmitting the electric fluid, whilst others are impervious to it, we likewise are to suppose, are rendered so by the phlogiston which they possess, as is eminently the case with metals and charcoal, which are the best conductors. And yet, the electric fluid, is of a different principle from that of fire. A metal may have a great degree of heat, without appearing at all electrified; and on the other hand,

hand, may be strongly electrified, without acquiring by it any sensible degree of heat. Fire penetrates every substance; whereas, the electric fluid, pervades only conductors. Lastly, the electric fluid goes through a very long conductor, in a space of time almost instantaneous, but fire is very slowly propagated. There are various other differences: notwithstanding all which, Mr. Henley supposes, that although the electric fluid be perhaps neither phlogiston nor fire, yet, it is a modification of that element, which, while in a quiescent state, is called phlogiston; and when violently agitated, is called fire. Hence, it may be concluded, that phlogiston, the electric fluid and fire, are only modifications of the very same element; the first being its quiescent state; the second, its first action; and the last, its more violent state of agitation: like fermentation producing first wine; secondly vinegar; and lastly putrefaction.

The different impressions which electricity makes upon our organs, indeed, proves it to be material. Some, it is true, have conceived this fluid to be nothing more than emanations from bodies, generated by friction. But this is palpably contradicted by experiment; for metallic bodies,

bodies, which are capable of the longest and the strongest degrees of electricity, lose nothing of their weight. Others have thought, it did not differ from air: but the electric light appears in a vacuum, and it moves with a celerity almoſt equal to light, and incomparably faster than sound, or the most impetuous wind. Moreover, it freely passes through metals that are impermeable to air, and it has an appropriate odour, and the taste of an acid. *

* Bertholon.

LET-

LETTER XXXIV.

NEWTON was led to conclude, that there is a fine fluid of the same nature with air, but extremely more subtile and elastic, every where dispersed through space, which fluid he called æther. That this æther is much more rare within the dense bodies of the sun, stars, planets, and comets, than in the empty celestial spaces between them; and in passing from them to great distances, it perpetually grows denser and denser, and thereby causes the gravity of those bodies towards one another, and of their parts towards the bodies; every body striving to go from the denser parts of the æther to the rarer: That, therefore, this earth is every where surrounded by this æther to a very great distance, in consequence of which, the air, and all bodies in it, gravitate towards the earth, and towards each other, agreeably to the appearances at the surface of it: That this æther, likewise, pervades the pores of all bodies, and

lies

lies hid in them; and whilst the bodies, with this fluid in them, are undisturbed by any external violence, this fluid from its elastic nature, confirms itself as to its degree of density, to the particular make of the body it is in; that is, it is not so dense in dense bodies, as it is in rare ones.

This æther of Newton, (for he candidly owned he knew not what it was) and the electrical fluid, may be therefore supposed at no very considerable distance from each other. The word electrical, indeed, is of too confined a meaning to be a proper epithet for a fluid of such universal activity; electricity meaning no more than the power given by friction, to attract and repel light bodies. Thus amber, which when rubbed, was observed to attract bits of straw, down, and other light bodies, was called *electrum*. The word æther, is Greek, αιθηρ, and derived from αιθω, to burn; because the ancient philosophers, supposed it to be of the nature of fire. Of this very subtile fluid, and which, like the electrical, is supposed to be *sui generis*, Aristotle says, Anaxagoras believed the most distant parts of space to be filled, looking upon it as a subtile and active fire.

What-

Whatever the ancients, however, might have conjectured of the etherial fluid, they had made little progress towards a knowledge of electrical phænomena; at least, we are forced to believe, from the want of explicit authority, although Pausanias talks of the bringing down the fire of Heaven to kindle the victims: and, although Tullus Hostilius is said to have been killed in drawing down the lightning. Pliny and Seneca, indeed, both allude to a something like electricity, but declare it was carefully kept secret, or veiled in a mystery: and even in Herodotus, we read of irons, which being fixed in earth, diverted the stream of lightning; but, it cannot be insisted upon, that this, more than the fire of Prometheus, was electricity. Des Cartes, in the prodigious grasp of his genius, seems to have been the first philosopher, who was led to remark, what electricity was. He acknowledges, he had not made experiments enough, to speak with certainty about it; but, nevertheless, the few phænomena which was known to him, had evidently for a physical cause, he said, the element of fire, which in rubbing, was obliged to fly out of the glass, and which the resistance of the air made to enter again. The electric matter, then, says he, is the soul of thunder. Thus conceived that wonderful

man,

man, and the idea has been since borrowed from him.

The electrical fluid is restrained when it acts in dense air; but it moves with the greatest liberty in a vacuum or rarefied air, as in an exhausted receiver. It is called, as we see, the æther or subtile matter, which fills the intervals between the planets. Now, we know, that water, whether in substance or in vapour, is a conductor of electricity; consequently, the latter becomes a canal of communication between this immense reservoir, this ocean of free electric fluid, and the entire mass of our globe. If then, this fluid, be more restrained at one part of our globe, than in corresponding parts of the higher regions, the vaporus will be the medium to restore the equilibrium. Hence it is that vapours never rise to a great height, without producing the most terrible meteors. All considerable volcanic productions, are accompanied with lightning. The fire which rises from the earth, seems to light that which comes from the Heavens.

The vapours of water, and in general, the parts of all bodies that are separted by volatilization, carry away an additional quantity of

electric

electric fluid, as well as of elementary heat. The air at all times appears to be electrified; its electricity is constantly positive, and much stronger in frosty than in warm weather; but, it is said by some, to be by no means less in the night, than in the day time. In general, the strongest electricity is observable in thick fogs; and the weakest, when the weather is cloudy, warm, and threatens rain. The more elevated the place, as you have experienced on the Alps, the stronger the electricity. But, is the electricity, which manifests itself at the moment a cloud passes over our heads, belonging properly to that cloud, or does it only serve the office of conductor, which transmits to us the electricity of the higher regions of the atmosphere? To me, says De Saussure, it appears clear, that it serves no other purpose than that of a conductor. M. Volta, that profound and ingenious philosopher, has made it evident, that the electric fluid enters into the composition of all vapours; and that, therefore, when the actual heat of the sun, or that which has been a long time accumulated on our globe, draws up in vapour the water spread on the surface of the earth; those vapours drag along with them, a certain quantity of the electric fluid. To a certain height, these vapours ascend. There, being checked by

by the cold of the medium, they condense; while the electric fluid that was combined with them, getting its freedom, accumulates in the highest regions, and there continues, until storms, rains, or other conductors, afford it an opportunity of returning to the earth, whence it had its origin.

The electric fluid varies in different places. It is, in general, strongest in situations the most elevated, and insulated. In houses, in streets, in allies, and, in general, in places closed around, it is feeble. * Nevertheless, it is sensible in cities; in the middle of large squares; on the borders of quays; and principally on bridges, where it is often found more forcible than in the open country. The hours, when the electric fluid appears feeblest, are those comprised within the time, when the dew of the evening has completely terminated its fall, and the moment of sun rising. From this period, its intensity augments by slow gradation, and arrives sooner or later, but always before noon, to a maximum; which passed, it seems to decline until the dew beginning to fall, it recommences its ascent, and then arrives at its greatest strength: from this time, it regularly diminishes, never, how-

* De Saussure.

however, becoming totally extinct, while the air is in any degree serene. The electric atmosphere is, therefore, subject to a flux and reflux like the sea, which increases and decreases twice in the twenty-four hours; but which is not caused, as I have ever heard, by any attraction of the moon. The moments of its greatest force, follow the rising and the setting of the sun; and those of its greatest weakness, are those which precede the rising and the setting of that luminary. In summer, on a serene day, the electric fluid is less strong than in winter. As to its quality, it is invariably positive, as well in winter as in summer; during the day, during the night; and, in short, at all times when there are no clouds in the heavens; and that the electric fluid, should be less strong in summer than in winter, is thus easily accounted for. The air, during the summer, is hot and dry to a considerable height, and, consequently, resists the illapse of the fluid, accumulated in the upper regions of the atmosphere.

This fluid, which appears to me, says De Saussure, to be the result of the union of the element of fire, with some other principle yet unknown to us; but, which though probably analogous to inflammable air, must yet be incom-

comparably more subtile, mounts inactive and invisible in the bosom of vapours; but eventually, when those vapours change their form, displays itself in all its energy. In the equatorial regions of the earth, the aggregate of it must be supposed the strongest; for, in those regions is the greatest degree of evaporation. Hence, it diverges towards the poles, in order that the equilibrium may be preserved, and in a very visible form presents itself as an aurora.

Before the universal agency of the electric matter was understood, the whole phænomena of the atmosphere were mediately or immediately supposed, to be connected with a nitrous principle. Thus the aurora borealis was looked upon as a nitro-sulphureous vapour, raised in our atmosphere, considerably higher than the clouds, where, by fermentation it took fire, and the explosions of one portion of it kindling the next, the flashes succeeded one another till the whole quantity of vapour within their reach was set on fire. Thus lightning, thunder, hail, and snow, were likewise said to prove, incontestibly, the abundance of nitre in the atmosphere; nothing else, it was thought, could be so powerfully concerned in producing congelation, the flashing of lightning, and the noise of thunder

But, later experiments have led us into more probable and satisfactory ideas, and the nitrous hypothesis has, in consequence, vanished. Each of the atmospherical phænomena hath been found to be accompanied by electricity. They all, in a great measure, are proved to be effects of the electric matter, operating variously, but, still deduced in the etherial expanse, by the attraction of accumulated vapour.

In a former letter, we had occasion to treat this subject at some degree of length; and we then found that it had generally been supposed, that the electric charges, which are exhibited in repeated flashings of lightning, are previously accumulated in the vapours, which constitute the cloud; and that these vapours, when they they become by any means overcharged with electric matter, or deprived of their natural quantity of it, discharge their superfluity to, or receive the necessary supplies from either the earth, or some neighbouring cloud, in successive explosions, until an equilibrium is restored between them. But, this, as we have just seen, is in some respects denied. The charge, it is said, does not reside in the cloud, or in the vapours of which it is composed, but in the higher regions, or in the air, which sustains them.

them. "The electric capacity of the air," says Mr. Oliver, "is lessened by condensation, and increased by heat." The different regions of the atmosphere will therefore become differently electrical: if from the contrary currents of air, which frequently take place in different heights of the atmosphere, those regions should by chance become situated over, or adjacent to one another, like strata of minerals in the bowels of the earth, what the metalline coating is to a pane of glass, the same will clouds be to these differently electrical regions of air, the electrical equilibrium of which may be restored, by means of spontaneous discharges through the pure air between the clouds.

And here it will not be amiss for us to recur, to what we have had already in some degree before us: I mean the conducting properties essential to the agency of this fluid. "The characteristic distinction between conducting and non-conducting substances in electricity," says Priestly, "is, that the former contain phlogiston intimately united with some base; and that the latter, if they contain phlogiston at all, retain it more loosely:" and thus, since no other substances, besides such as contain phlogiston, are capable of ignition, and consequently of be-

coming luminous, it is evident, that light and phlogiston are the same thing, in different forms or states. The word phlogiston, indeed, is used in preference to fire, as Newton's elastic æther was to the burning æther of the ancients; because heat is inseparable from fire, and consequently embarrasses with the distinction of fire, in a state of action, and fire inactive or quiescent: because, if phlogiston and the electric matter be the same thing, though it cannot be exhibited alone in a quiescent state, it may be exhibited alone, under one of its modifications, when it is in motion: and because, if light be also phlogiston, that is, a diluted phlogiston, or some modification, or sub-division of phlogiston, the same thing is capable of being exhibited alone in this form also. But heat, it is said, is a principle distinct from phlogiston, and dispersed throughout the bodies of the universe. "When the natural dispersion of heat is disturbed," says an accurate experimentalist, "so that some bodies are made to part with a portion of their natural quantity of it, and others are made to acquire it, then a sensible heat is produced. Those bodies which contain a great quantity of phlogiston, have but a small quantity of elementary heat; on the contrary, those which have the least quantity of phlogis-

giston,

ton, contain the greatest share of elementary heat. *

And yet it is a curious fact, that on an attentive examination of the bodies which receive and lose their heat soonest, when they are placed in mediums of different temperatures, they will be found to be the same, which receive and lose their electricity with the greatest facility. Thus, to descend to gross and common material instances: metals, which become warm, or grow cool the quickest, are the substances which receive and part with their electricity soonest. Wood, which requires more time to be heated or cooled, receives and looses electricity slower than metals. Lastly, glass and resinous substances, which receive and lose slowly the electric fluid, acquire with difficulty the temperature of the medium which surrounds them. An iron rod heated red hot, cannot be held in the hand at the other end, because the iron conducts heat readily. But a tube of glass of only a few inches long, may be held in the hand, even while the other is melting. And thus it is with the electric fluid.

* Cavallo.

In the boundless regions of space, what a mighty ocean of this fluid must be accumulated. One thing is in common, we know, to all the celestial bodies, and that is light. If light, therefore, be a modification of phlogiston, and phlogiston and the electric matter be one and the same substance, how infinite its extension, and how all powerful its operations. But, "thy strength, O God, is in the clouds." And on this subject how much are we indebted to the labours and experiments of the present ages. At first, men knew not whence the causes of these phænomena were to be deduced. All was darkness and illusion. The light conferred upon us by the God of Nature, shone around our heads. But, yet we knew it not. At length came the immortal Newton. With timid and with cautious mind, he dared in secret to contemplate it. At last emboldened by success, and fortified by experiment, he perceived, he grasped it in demonstration. He then rent the veil of ages, and shewing his prism, said, "behold the proof of the decomposition of the rays of light."

The precipitations, which, in various shapes, we derive from our atmosphere, and for which we in general are indebted to electricity, have already

already engaged our attention. We shall, therefore, here, only throw a transient glance upon them. Hail is supposed to be found in the higher regions of the air, where the cold is intense, and where the electric matter is very copious. Here, the particles of water, being brought nearer together, freeze, and in their descent, collect other particles. So that it is observed, on mountains, that hail-stones, as well as drops of rain, are very small; there being but a small space through which they can fall, and thereby increase their bulk. Drops of rain and hail also agree in this particular, that the more intense the electricity is that forms them, the larger they are. Motion is known to promote freezing; and so the rapid motion of the electrified clouds may promote that effect in the air. But, the philosophy of snow is pretended to be this: the particles of all salts, say its tenacious supporters, have a natural disposition to run together, and constitute some particular or spherical form; and as these particles are originally and in themselves transparent and clear, as glass or crystal, this natural action of shooting into particular forms, is called crystallization. Water is an insipid fluid salt. In the upper regions of the air, nitrous salts abound, and there the disposition of freezing or congelation is great; especially when the atmo-

sphere is most heated by the sun's rays. In these regions, the aqueous particles, mixing with the nitre, immediately shoot into crystals, and form the original parts of snow, whose figure is wonderful, being strictly mathematical. These snowy crystals, being of an hexagonal and ramous form, inclines them to hitch and hang upon each other, till they make a body too heavy to be supported by the air, and then they descend in the form of flakes of snow, which are smaller or larger, according to the degree of cold which forms them. *

The clouds, from whose bosoms these phænomena are deduced, serve, however, as we have already remarked, as conductors to the electric fluid, which, in its moments of energy, is tremendous,—as in lightning, and in consequent thunder. But, there has been another mode, in which it has been lately discovered to operate, which is most curious and interesting, and which is, in familiar language, called a returning stroke. Suppose a cloud, or an assemblage of clouds, for instance, to be extended horizontally several miles in length, with another cloud under it at the hither end, and under this last, a man standing upon a little eminence on the earth. The clouds being supposed electrified, positively, for instance,

* Philosophical Transactions, 1787.

instance, and the man being supposed within the influence of the electric atmosphere of the lower cloud, the electric fluid, naturally belonging to him, will necessarily, by the elastic electrical pressure of the atmosphere, be forced down into the common stock of the earth. If now, the upper cloud, at its further extremity, approaches to the earth within the striking distance, and discharges its fire, that explosion, to spectators situated near the hither end, will be distant thunder and lightning; but, the lower cloud, at the same instant, discharging its fire into the upper, the report only of this explosion will be perceived, the interposition of the opaque cloud preventing the flash from being visible on the earth. The electric atmosphere of the cloud being thus suddenly removed, the electric fluid, which had by the pressure of the atmosphere been forced out of the man, will suddenly return into him from the earth, with a velocity, and consequently with a force, which is more than adequate to the production of the most fatal effects. *

That the electric matter, which forms and animates the thunder clouds, issues from places far below the surface of the earth in which it

* Earl Stanhope.

has buried itself, is probable, from the deep holes which have been made in many places by lightning, and by the violent inundations which have accompanied thunder-storms, not occasioned by rain, but by water bursting from the bowels of the earth, from which it must have been dislodged by some internal concussion. The prodigious quantity of electric fluid, which continually descends from the upper part of the atmosphere, filtrating through the air, to penetrate the interior parts of the earth, must necessarily be brought back again by some means; for, otherwise, the air would be exhausted of its fluid, or the earth would be saturated. The very wonderful celerity of this fluid, also, must render such a return necessary. Several experiments have been made, particularly by Dr. Watson, to ascertain the distance, to which the common artificial electric shock might be conveyed, and the velocity with which it moves. In the first of these, the shock was given to spirits fired by the electric matter, which had been conveyed through the river Thames. In the next, the electric fluid was made to pass through a circuit of two miles, crossing the New River near London, twice, going over several gravel pits, and a large field. It was afterwards conveyed through a circuit of four miles. It

passed over these spaces instantaneously, as to sense; for the observer, though in the room with the charged phial, was at the same time in the middle of a circuit of two miles, and felt himself shocked at the same instant he saw the phial discharged.

Besides what we have already mentioned, whirl-winds and water-spouts are justly to be reckoned among electrical phænomena. In order to represent the latter, for instance, place two boards at the distance of about two inches from each other; put a large drop of water about the middle of the lowest of them, and fix a metallic ball, or any piece of metal that is somewhat spherical to the upper board, just opposite to, and at about half an inch distance from the surface of the water. If in this situation, the upper board be electrified, whilst the lower communicates with the earth, the water, which represents the sea, will be attracted by the metallic ball, which represents a cloud, and rising nearly in a conical body, will afford a pretty good representation of a water-spout. Buffon, indeed, differs from this opinion. "M. de la Nux," says he, "thinks, and perhaps with reason, that water-spouts are nothing but viscous portions of a cloud, driven off by different

rent whirl-winds, (or a conflict of different winds) that is, by the whirlings of the superior air, sinking into the mass of vapours, of which the whole cloud is composed. The tenaciousness of their cohesion, and the inflexions and curvatures they make, seem to prove them to consist of viscous parts. For instance," continues he, "water-spouts descend from the cloud to the surface of the sea. The water must boil and whirl at the place to which the end of the water-spout is directed, because, the air blows from the extremity, like the tube of a pair of bellows. The effects of this blowing upon the sea will augment, in proportion as the cylinder approaches the surface of the water. It has been imagined," says he, also, "that water-spouts carried off, and contained great quantities of sea water. The canal of water-spouts is always transparent. If the water of the sea seems to rise, it is not in the canal, but only on its sides. Hence they cannot contain a certain portion of water, either to be poured into the sea, or to be raised to the clouds. They are solely composed of air in a viscous cloud, and determined by its whirling to the surface of the sea. This viscosity proceeds from the greasy bituminous particles raised from the sea. They are rarely seen on land, which is accounted for by land not having

having a sufficiency of bituminous, oily particles, to be exhaled by the sun." But, this is far from a satisfactory explanation, though it discovers the usual ability of the author. In the first instance, there are no bituminous particles in the waters of the ocean. Secondly, the water-spout is indisputably an electrical phænomenon, and the water is attracted from the sea by the impending clouds. Nor is it strange that water-spouts should not be frequently seen over land. The fact is, they form only over waters. But, their substitute, the whirl-wind, is daily to be observed over land. And as that draws up terrene bodies, so does the water-spout draw up aquatic bodies.

Their circular, more than their elevating or progressive motions, is, however, the phænomenon most difficult to be comprehended. In general, whirl-winds are seen to rise after calms and great heats; and the same is observed of water-spouts, which are therefore most frequent in the warmer latitudes. The wind blows every way from a large surrounding place to a whirl-wind; the same happens to a water-spout. Thus, a fluid moving from all points horizontally towards a center, must at that center either mount

mount or descend. If a hole be opened in the middle of the bottom of a tub filled with water, the water will flow from all sides to the center, and then descend with a whirl; but, air flowing on or near the surface of land or water, from all sides towards a center, must at that center ascend; because the land or water will hinder its descent. In this manner local lower heat, and proportionate superior cold, causes the rarefaction, which gives the spiral ascent. And hence, it is easy to conceive how the water, for instance, which is taken up and blended with the clouds, has successive condensations from above, and that the spout appears to drop or descend from the cloud, although, in reality, the materials by which it is composed, are all the while ascending.

From these distant enquiries, however, we will now, if you please, descend nearer home. The electric fluid, which falls upon the earth, is attracted by the tops of trees, the points of leaves, and the beards of grains, and is forced to pass through the vegetables, of which it becomes perhaps, when decomposed, the most active and savoury part; otherwise, why do plants, which grow on bare insulated rocks, surpass in flavour

and

and medicinal virtues, those of the same species which grow in the level country?* Animals themselves, do they not partake of this same fluid? Can it be doubted that the gentle and continual electrification to which a man is subject who moves in open air, in an elevated situation, has an influence on his organs, on the circulation of his blood, on the secretions of the humours, and on the insensible perspiration, and that this is one of the reasons why exercise taken in open air, is much more contributive to the preservation and to the re-establishment of health, than that taken in places, shut in and inclosed? In comparing the air in the inside of houses, with the external air, as relative to electricity, I have always found the same result, says De Saussure, as in comparing the surface of the earth with the external air; that is, that the electric fluid has the same density in the inside of houses, that it has at the surface and beneath even the surface of the earth: and it is natural to conclude it should be so, seeing that the walls of houses communicate with the earth, and that they are tolerably good conductors.

In the spring, when plants begin to grow, temporary electrical clouds begin to appear, and

* De Saussure.

and pour down electric rain. The electricity of the clouds, and of the rain, continues to increase, till that part of the autumn, in which the last fruits are gathered. It actuates and animates vegetation. It is the agent that collects the vapours, forms the clouds, and is then employed to dissipate them in rain. This great principle, as I have already said, is neither generated nor destroyed; it is every where, and always present, though latent and unobserved, and is in motion by day and by night. The supposition of an ingenious writer is, indeed, by no means improbable, that the vegetating power which is operating during the whole year in *ever-greens*, may arise from these trees having more resin in their composition, than those whose leaves fall in autumn, by which they are enabled to attract and retain those juices, which give them their continual verdure, and supply in some degree the absence of solar heat. And this is confirmed, by the strong electric power possessed by their leaves. The same writer thinks, the fluid collected in our electrical experiments, is only those solar rays, that have been dispersed in, and are arrested by the earth; an idea, which is strongly corroborated by the observations made on atmospherical electricity, and by the deductions which have been

been made from the relative affinities of fire, light, and heat.

The electric fluid is essentially connected with the human frame, and is continually exerting its influence upon it. Hence we may perhaps find, that what we call sensibility of nerves, and many other diseases, which are known only by name, are owing to the bodies being possessed of too large, or too small a quantity of this subtile fluid, which is perhaps the vehicle of all our feelings. Thus, says Brydone, in his Animated Observations on Scicily, in damp and hazy weather, when this spirit seems to be blunted and absorbed by the humidity; when its activity is lost, and little or none of it can be collected, we ever find our spirits more languid, and our sensibility less acute: but, in the Sirocco wind at Naples, when the air seems totally deprived of it, the whole system is unstrung, and the nerves seem to lose both their tension and elasticity, till the north, or west wind, awakens the activity of this animating power, which soon restores the tone, and enlivens all nature.

This vivifying fluid does in fact communicate itself to the human body, and not only by the pores, but also by the lungs, which Berthollon

lon looks upon as the secretory organ of aerial electricity: and, as we also conjectured in a former letter, when treating of airs, and of the highly phlogisticated state of the blood, which is attenuated and rendered florid, by apparently nothing else than the action of the lungs, and the influence of the dephlogisticated fluid, which keeps them in motion. The effects, indeed, of electricity on the general system, is wonderful; and consequently on the vital frame, and on all animal functions; such as muscular motion, respiration, digestion, and the various secretions. But, respiration is the powerful act, by which man imbibes the greatest quantity of this fluid: for it has been calculated, that the motion of respiration is repeated 28,800 times every day, and that the lungs receive in that space of time, one million, one hundred and fifty-two thousand cubic inches of air. Bertholon, moreover, proves the influence of the electrical fluid upon vegetables, by their analogy with animals, by the nature of the fluid itself, which must pervade them; by the distinctive characters of the electrical phænomena, such as lightning, thunder, rains, northern lights, water-spouts, &c. by the influence even of snow, hail, and mists on the vegetable kingdoms; by the quantity of water, which the atmosphere receives from seas, rivers,

lands,

lands, animals, and plants; and by the nature of that water, which, as it is an excellent conductor, falls from the clouds, impregnated with the electrical fluid, and discharges it upon the earth. The force of vegetation, says he, is principally owing to the electrical fluid, with which this rain water is impregnated, and not to those aerial nitrous vapours, which have hitherto been considered by many, as its principal cause. Those years, in which thunder storms have announced the greatest measure, and activity of the electrical fluid, have been most distinguished by the speedy maturity, and by the abundance of fruits and vegetables. And this may be readily proved, by depriving water of the electrical fluid, which it has imbibed in the atmosphere, when it will be found to be deprived of the greatest part of its nutritive power, and of its influence on plants.

Thus, perhaps, of all the causes assigned for the wonderful vegetation that is observed on Ætna, there is none that contributes so much towards it, as the constant electrical state of the air. The vapour of volcanos is highly electrical. Penetrating the vegetables, it drives the juices through the smaller vessels with increased ease and celerity. It is, in short, the soul that

quickens them, as it does every other organized body in nature; and there is little doubt but that the fertility of seasons depends as much on this quality in the air, as either on its heat, or on its moisture. * And perhaps we may be allowed to venture still farther. Pass the charge of a large jar or battery, from the head to the back of an animal; this, if sufficiently strong, will kill it. After its death, make the discharge in the same manner, and the fluid will pass visibly over the body, and not through it; evincing, that the power, or medium, which transmitted the shock through the animal, is *lost* with *its life*. But, what is this medium? I fear it is not yet well understood. For it is said, that all parts of the animal frame, while they preserve their *juices*, give a free passage to the electric fluid: but, if these parts be dried, the passage of the electric fluid is stopped. What is here meant, are the solids, or those parts which tend to solidity. The blood, the saliva, the serum, &c. being fluids, give a free passage to the electric fluid. But, the arteries, the veins, the intestines, the bones, the nerves, &c. after they have become dry, cannot be employed either in the charging, or in the discharging of a phial. †

The

* Brydone. † Steighlehner.

The universal and powerful agency of this fluid is astonishing. Instances of the human body becoming electric, even without the mediation of any electric substance, have been known; and of its even giving sparks, with a disagreeable sensation, and an extreme degree of nervous sensibility. De Saussure and Jalabert, when travelling over one of your neighbouring Alps, were caught among thunder clouds; and to their utter astonishment, found their bodies so full of electrical fire, that spontaneous flashes darted from their fingers with a crackling noise, and the same kind of sensation, as when strongly electrified by art. Cassini relates something still more wonderful. He mentions the very singular case of a Russian gentleman, whom he met with at Florence, who, during two different years of his life, had in his body an electrical virtue similar to that of the torpedo; as also the case of a woman, who though six months advanced in her pregnancy, and suckling a child, was affected in the same manner.

In the moments of storms, it is alleged, that the beaks of birds have been often observed charged with the electrical fire; nor is such a phænomenon difficult to be accounted for. Eagles, for instance, soar into the regions of electricity.

Man himself would be probably radiant, if elevated into the same medium. Was it not from this, that the eagle was looked upon by the ancients, as the bird of Jupiter—the attendant upon the Almighty Thunderer? *

There are few fables, which have not some truth on which they have been founded. During the rage of a hurricane, the masts of ships have frequently been seen exhibiting electrical lights. In a thunder storm at Rouen, a man who was hurrying into shelter, appeared to every one who saw him, as if entirely on fire. † But, who is there of delicate nerves, who does not feel every electrical change in the atmosphere? We are all affected by change of weather. And what is this change, but probably the lesser or greater quantity of electricity in the air by which we are surrounded? No one is ignorant, that persons of weak lungs, suffer considerably, when the air is keen, and much charged with the electric fluid; as for instance, in elevated situations: but, that on descending into regions where the electricity is less powerful, they find themselves relieved, and no longer suffer in the breast. Men, who have had a limb fractured, who have lost a leg, an arm, or a finger, often feel *shocks* in the

* De Montbeilard. † Mongez.

the parts where they have suffered, on the approach of a storm, and that in a greater or less degree, as there is a greater or less quantity of electricity in the atmosphere. Observe animals, birds particularly, how sensible they are to every electrical transition! The functions of animals, even the instruments of their will, and the vehicles of their affection, may be some day or other discovered, to be this electrical fluid. * When the storm begins to growl, look at the fishes, how they rise to the surface, and how invigorated they seem to become in a moment. Insects, and reptiles, also burst from their nests, and annoy us with noise and with bites. The louder the thunder, and the more fervid the lightning, the more animated they appear. † Does not this prove the influence of the electricity of the atmosphere on the children of creation?

In some instances, indeed, but those have very rarely occurred, men even have been found, on whose frames electricity has appeared to have had no decided effect whatever. But, in general, we are sensibly affected by it. Many people, in combing their hair in the dark, draw electric sparks. Angry men's hairs have been said to stand on end, and to sparkle. What are we to

* Ducarle. † Cepede.

think of the palpable fire, said to start from the eyes of Alexander, in the heat of battle? Tullus Hostilius is reported to have had at times, while an infant, a glory which irradiated his head. *

Ecce levis summo de vertice visus juli
Fundere lumen apex tactuque innoxia molli
Lambere flamma comas, & circum tempora pasci. †

Frictions, and sudden shocks, electrify the nerves. Whence is the luminous and coloured circle, tinged like the peacock's tail, which is observed in the dark, if the corner of the eye be rubbed? Or whence are the stars, which in the day-time are perceived, if a blow be received upon the eye? ‡

However remarkable these circumstances may be thought, it yet is not a little extraordinary, that aerial and terrestrial animals should so rarely have the dispensing power of this etherial fluid, while, at the same time, there are classes of beings belonging to the element of water, which are most powerfully invested with it. Thus, for example, we have the torpedo, or electric ray; the gymnotus electricus, or electrical eel; and the silurus electricus, with some

* Livy. † Virgil. ‡ Newton.

some others, that have the amazing property of giving shocks analogous to those of artificial electricity; and shocks, too, which evidently depend on immediate volition. In the forms in which we generally see the operations of this fluid, certain characteristics peculiarly mark it; for instance, besides its celerity and subtilty, we find an unequivocal attraction and repulsion. Yet, in these fishes, as if they had no power to throw their electrical influence beyond the limits of their own system, we find they are unable to attract, or to repel the lightest substances, which even the electrum can affect. They have a power, indeed, of diffusing this fluid, and consequently can strike other animals at a certain distance: but, repulsion and attraction are denied them.

In all the experiments which have been made on electricity, it has invariably appeared, that it not only is evermore about us, however invisible, but, that it is intimately connected with, if not absolutely the support of our mortal existence. At the same time, we must reflect, that as it supports life, so it as inevitably causes death. In man, it is the vital spring; in plants, it is the vegetative one. But, in the tremendous struggles of the atmosphere, it inflicts wide,

and

and irresistible destruction. Much caution, consequently, should be at all times exercised with respect to this powerful agent in nature.—In saying this, I am far from wishing to give rise to unreasonable apprehenion. It yet is curious that our females, who have their heads surrounded with wires, and their hairs stuck full of metal pins, and who at the same time stand upon dry silk, are, to all intents and purposes, electrical conductors, insulated, and prepared, for collecting the fire from the atmosphere. From this circumstance, indeed, as well as from their superior nervous sensibility, may not some part of their irresistible liveliness and vivacity be deduced? Nor would I for a moment, that they should be divested of such innocent decoration. This world of ours has long gone round, and pins and bodkins have had an old and venerable standing; nor have the instances, I believe, been more frequent of female deaths by lightning, than of male. But, I would, if possible, be the means of warning our amiable friends to cast away such conductors, if ever so unfortunate as to be overtaken by a thunder storm. Then, indeed, the less armed they stand, the better. And one woman saved, is of consequence to the world. But, as the effects of the electrical fluid may be fatally pernicious, so may it, as I have said, be readily turned to

the most beneficial purposes. Thus, perhaps, says Brydone, it might be of service to invalids, or hypochondriac people, to wear some electric substance next their skin, to defend the nerves and fibres from the damp, or non-electric air: a waistcoat of the finest flannel, for example, which should be kept perfectly clean and dry; for the effluvia of the body, in case of any violent perspiration, will soon destroy its electric quality. This should be covered by another of the same size, of silk. The animal heat, and the friction that exercise must occasion betwixt these two substances, produce a powerful electricity, and would form a kind of electric atmosphere around the body, that might possibly be one of the best preservatives against the effect of damps.

The pores of the skin are so many mouths, to inhale, and absorb the electric fluid. A sponge does not take up water with greater avidity, than the body of man does, the electric fluid. Nor when we consider the almost inconceivable number of these mouths, is it at all surprising. A grain of sand is of magnitude sufficient to cover two hundred and fifty thousand of them. * And a molecule of electricity is as tenuous, as a particle

* Leuwenhoek.

ticle of light. Through these pores, the electric fluid rushes into the profoundest depths of the system. They are the bridges of communication, erected between the electrical state of the atmosphere, and that of the human frame. * But, besides the pores, the lungs, as I have above observed, lend a powerful aid. Here is the great seat of the electrical process. Here is the grand porous laboratory, whose capacity is so enormous, as to have nineteen times a greater surface, than the outward skin of the whole body. †

As fishes are plunged in water, so are we plunged in electricity. We are powerfully affected by it, in our progress through life; nor are we less so at our births, and at our deaths. In the generation of animals, it has been observed, that the electrical influence has, on experimental application, been found to accelerate fecundation. Electrified eggs have been hatched before those which were not electrified; and this, merely, because the pre-existing animal only waited the developement of its parts. ‡

Life

* Fontenelle. † Hales. ‡ Haller, Bonnet, Spallanzani.

Life and death are the two extremes of the same cause. In the city of Lyons, with the same population, the number of births in the year 1770, exceeded the number of births in the year 1768, four hundred and four. During the former, the electrical state of the atmosphere was powerful. A northerly wind prevailed 220 days, and a northerly wind is favourable to electricity: whereas, during the latter, a northerly wind only prevailed one hundred and sixty-three days. Besides which, the year 1768, had forty-six days more of a southerly wind, which is unfavourable to electricity, than the year 1770.*

In regard to lingering deaths, the number of men who die in calm and serene weather, is remarkably smaller, than of those who die in unsettled weather. But, of sudden deaths, the case is wonderful. Out of fifty-six sudden deaths in the city of Padua, during the year 1774, forty-eight are said to have happened during unsettled weather, and only eight during atmospheric calmness and serenity.† Maladies, particularly *lunacy*, is conceived to be greatly affected by the electrical state of the atmosphere. An animal, deprived of every appearance of life by the poisonous action of a mephitic air, may, we

* L' Abbe de la Croix. † Journal Mortuere.

we are told, be speedily re-vivified by the electric process. Volatile alkali, cold water, friction, the open air, and fumes of tobacco, are all good remedies; but, electricity, in case of *asphixie*, is held by some physicians, to be more efficacious. * The reasoning upon the electrical influence has, indeed, been carried to a great length. Bertholon concludes a chapter with saying, that man and wife, who both abound in the electric fluid, will enjoy less perfect health, than if the electrical constitution of the one be feebler than that of the other, and the same with those who have less of the fluid than is necessary. Ought not the want of one party, therefore, says he, be apportioned to the excess of the other? And in so apportioning, might not the races of mankind be not only increased, but as they say with horses, the breed be mended?

In mentioning, as I have done above, the ladies dress, I would not be understood to condemn altogether the articles of which it is composed. On the contrary, silk shoes, silk stockings, *insulate*, and consequently when the body is in want of *positive* electricity from the atmosphere, may be salutary. Those, indeed, who abound, and who would be better from *negative* electricity, should follow a different plan, and should wear those materials,

* Changeux.

materials, which are known to be the best conductors. Valetudinarians, we know, who are of a weak temperament, are benefited by moderate exercise, (for violent exercise is not favourable to electricity) by daily walks, and by other gentle modes, whereby the friction of the fluids may be occasioned; likewise, by wearing flannel next the skin, and by rubbing the flesh with flannel, in rheumatic and other chronic complaints. This is nothing more nor less, than simple, unscientific electrization. It has the advantage, likewise, of the artificial in general, for it is constant; whereas the application of the other is only momentary. From time immemorial, old nurses have been well acquainted with the virtues of flannel. They never, indeed, dreamed, it generated electricity, any more than the freedman of Tiberius, who pretended to know, that the shock of the torpedo would dissipate the gout. In a word, they who have the animal electricity too feeble, should breathe an air fresh and dry, that is to say, strongly electrified; and hence their rides should be upon elevated grounds, and distant from rivers. Those, on the contrary, who have the animal electricity too powerful, should follow an opposite plan. They should seek a warm and a humid air, which diminishes and absorbs by its conducting properties, the superabundance of the electric

electric fluid. And hence, likewise, in diet, the phlogistic will be found beneficial to the one; the antiphlogistic to the other. Head aches, we know, are cured by the application of negative electricity. The fire is drawn from a heated brain, by the application of a nap-kin dipped in the good but simple conductor, cold water.* Electricity, to conclude, may likewise have more influence than we are aware of, on the moral character. It probably does not act upon us entirely *physically*. No one is ignorant, that the imagination is more brilliant, when the electricity is strongest in the atmosphere, than when it is weakest; when the day is clear and enlivening, than when it is vapid and gloomy. Experience proves this to every man, and in every country. The same may be said of our dispositions and propensities. When the machine is in order, its functions are cheerily performed. When out of order, its wheels are clogged, and its progress is disturbed. From the same cause, the natural character of nations may arise, however subsequently moulded, either as to mental, or bodily ability.

I now have done, with only recommending to you, to avoid trees, if ever you should be surprised

* Bertholon.

prised by the electricity of the atmosphere, that is by lightning. They not only attract, but they disperse the fluid from every branch to the trunk. So certain is this, that it is said, *a chesnut*, or any other tree with pointed leaves which tend upwards, and planted near a house, will, in a thunder storm, save that house from lightning. The points are all attractors of the fluid, and the leaves, branches, and trunks, serve as conductors. "In countries, where thunder storms are common," says Faujas de St. Fond, this phænomenon is frequently observed. Thus one tree planted with judgment, may be as effectual a conductor to a poor man's cottage, as Franklin's chains are to a palace. You will likewise forgive me for reminding you, that, however generally diffused these electrical phænomena may be, they are not to be confounded with those *ignes fatui*, which glide along burying grounds, and which the superstitious people suppose to consist of the spirits of the departed. Such are merely of that sort of air, (proceeding from putrescent bodies, indeed, though not from wandering souls) which burns at the surface of certain springs, and consists of hydrogenous gas, holding phosphorus in solution. This same phosphorus and oil, as you have often seen, appears naturally to exist in the glow-worm. Henckel, even reports that one of his friends, of a

sanguine temperament, after having danced much, traces of a phosphoric flame were seen on his ſhirt, which left yellow red spots behind them, resembling the residue of burned phosphorus; and that this light was long visible.* These phosphorus substances, likewise, have been said to be distinguished from pyrophori, inasmuch as though they take fire on being exposed to the air, they yet are entirely destitute of light before this exposure. Dephlogisticated air, as the exclusive pabulum of fire, you have already seen the arguments for. Dr. Hare, however, was determined to try this with respect to phosphorus; and for this purpose, he placed a large piece of phosphorus in a receiver. Upon exhausting the receiver, he perceived it became more luminous; and that upon admitting the atmospheric air, it returned to its former state. This property, indeed, of the light of human phosphorus is different, we are told, or rather the very reverse of that of shining wood and fishes, and this from the very accurate experiments of Mr Hauksbee.

* Pyritologia.

LETTER XXXV.

FROM the summit of the Alpine Mountains, we thus have forced our way into the regions of etherial space; and thence darting our eye through the cloudy and turbulent medium that intervened, at length have humbly rested ourselves on that parent earth, where, in the most sensible manner, we can investigate the powerful effects of the phænomena of nature. Nor in so doing, have we mispent our time, in airy, or in visionary speculations. Conjecture, it is true, has sometimes kept us on the wing; but, experimental certainty, has generally been our support. This mode of philosophical discussion, now indeed common, is in every respect different from that which was in use among the ancients. Seas, mountains, caverns, even the tractless wilds of the atmosphere, and the awful profundity of the ocean, are now explored in pursuit of knowledge. Labouring up the rugged eminences of Mont Blanc, how glorious the philosopher appears, who attempts, and at length compasses its hoary top. To men of such indefatigable in-

dustry, how much are we indebted? The sages of antiquity encountered no such difficulty, although Aristophanes, in his comedy of the Clouds, ridicules the Socratic astronomy, geography, comparative anatomy, entomology, and meteorological observations. Democritus retired to the tombs of Abdera, and wished himself blind, that he might think with greater freedom, and that without absence of mind, he might order the world he had prefigured in his head. Epicurus, how much soever he might know of mind, knew comparatively nothing of matter, excepting his garden. The study of the particulars of nature, and the toils of experimental researches, would have offended his indolence. The Platonists, Peripatetics, and Scholastics, at all times despised terrestrial, and peculiar studies. Such mechanical pursuits, they left to artificers, in order the better to busy themselves in abstractions. Plotinus spoke the sense of his sect, when he fancied he had abstracted himself so far from matter, that he declared, he was ashamed to wear a body. In short, always amused about generalities, they hardly knew any thing but their own thoughts, and scarcely vouchsafed to study nature in the volume, in which every ordinary man can read.

Not

Not that it would be right to say, that contemplation, and mental energy, should be banished altogether. This extreme would be as extravagant as the other. For if we would proceed justly in our inquiries into natural things, we must of necessity, mix the two means of knowledge, and join reason with experiment: otherwise, we shall come to a knowledge of gross things only; and by discarding our reason, yield up all to sense, and so contract our knowledge into a narrow compass. But how long, had not even our modern world, groaned under the yoke of Aristotle, until at length Des Cartes, with a powerful and daring genius appeared, and undertook to break the chain? To his contemporaries he said, "To be a philosopher, it is not enough to believe, you must think." But, all flew to arms. An old maxim still reigned paramount, *ipse dixit*. Their prejudiced minds became irritated. They could not conceive that they were born to think, and examine for themselves. Des Cartes was persecuted, and driven from kingdom to kingdom. And he who would have awakened mankind to a sense of their own power and dignity, was fated to breathe his last on an alien soil.

Experimental philosophy, indeed, was far from being unknown to the ancients. But, they do not seem to have prosecuted it with the intrepidity it has of late days experienced. Nor did they clearly understand, that the end of chymistry, for instance, was to discover and to be informed of the nature of bodies, and their action one upon another; and the nature of physics to discover, and to be informed, of their masses, and their properties. Thus, "ubi desinit physicus, ibi incipit chimicus." The greatest misfortune, however, that then and since hath happened to real and unsophisticated knowledge, has been, that authors, almost in all ages, have been touched with the ambition of being mysterious, as if learning grew more honourable, in proportion as it became less intelligible. The astronomer, the navigator, the engineer, must be mathematicians, and it may perhaps be well for the philosopher, if he be so too. But, the properties of the elements are opened to us in a more simple manner, and in great measure by the common experiments of chymistry.* Electricity has but little to do with calculation; and the philosophy of the three kingdoms, of plants, animals, and fossils, are full of wonders, and

* Philosophy of the Elements.

and may be treated without the formulæ of algebra.

By pretending, by mere contemplation, to unlock with ease and expedition the secrets of nature, the natural rage of explaining all things is, indeed, soothed; and by supposing every thing accessible to the human intellect, pleasing flattery is administered to vanity and ignorance. The philosopher at his table, surrounded with books, undertakes to penetrate the arcana of nature, and to deal out truths as by inspiration. The time, however, employed in this manner, would surely be better applied in experiment and observation.* When the bold speculator, assuming matter and motion, begins *ab ovo*, and constructs the world, imagines certain forms, and led away by what is called sublimity of imagination, connects and demonstrates mechanically, *a priori*, every phænomenon, and every operation, a stupendous but visionary structure will appear; but being reared without foundation, it must necessarily fall to ruin. It was not thus the immortal Newton presented himself. That illustrious philosopher, rendered cautious by the failure of his predecessors, acknowledged that a conception of the *theory of creation*, exceeded

* Bergman.

human powers. He, therefore, followed the inverse method. He first solicitously collected facts; these he examined with accuracy, and compared with acuteness: thence he deduced the laws of nature, and from effects well established, he inferred their causes

Bacon well says, "that one who begins with certainties, shall end in doubts; but, if he will be content to begin with doubts, he shall end in certainties." Thus it has happened, that when any one has made a progress, or some useful discovery in physics, it has been by trying, not indeed to know every thing, or to explain the origin of things, but only to know a little more than what was known before; above all, to be able to render science intelligible, if not by its clearness, at least by a sensible certainty; and for want of the first causes, which remain concealed, to be contented with taking, for so many principles and guides, certain effects, constantly known the same by observation, and by the testimony of our senses.

From the inquiries we are at present engaged in, it is clear to unprejudiced reason, that experiments in philosophy should unremittingly be made. For the elucidation of the simplest appearances

pearances of nature, it is even necessary that their chymical analysis should be understood Certainty can be established in no other way. "The man who first saw a metal corroded by a limpid menstruum," says Bergman, "and in such a manner, that a body so extremely ponderous and so opaque, should gradually and entirely disappear, and afterwards, upon the addition of a suitable precipitant to a liquor, which appeared simple and homogeneous, saw that metal separate, and again come into view, must have been struck with astonishment." But, what was this compared with what we have seen, in the compositions, and decompositions, of the elementary principles of the great bodies of nature? In every corner of the earth, incessant transformations are going on. Nothing stands still. Menstrua, and precipitants, are every where at work. The chymical phænomena of this uncircumscribed laboratory are, perhaps, as boundless as the immeasurable space itself.

Æther, or elastic fluid, say the disciples of the old schools, is the father of all things, the soul of existence. The air is the second principle, or the receptacle of the vital spirit of the macrocosm. They are neither of them emanations from above; they proceed from the aqua-

tic and terrestrial spheres. Every substance that partakes of the principle of air, whether animal, vegetable, or mineral, throws off its superfluities. These ascend. Air is the element, whereby the æther is connected with the waters and the earth. The water and the earth hold together, as the æther and the air. Water is the third principle, and the universal menstruum of nature. The earth is the fourth principle, and the womb of all sublunary things. It is a fixed æther, a condensed air, a coagulated water; in like manner, as minerals are fixed vegetables, animals volatile vegetables, and vegetables fixed animals. Thus the air is agitated by the æther, the air agitates the water, and the waters agitate the earth, which in its turn sends up its exhalations, and so the circle is continued.

Now this is more philosophical, whatever we may think of it, than the vortices of Des Cartes, or the monades of Leibnitz. It is at least not so imaginary. It steers clear of the fatal assumption of physical elements, merely upon the grounds of mathematical conclusions. But, not to dwell on this, chymistry, even though our best aid in natural investigations, is yet far from being infallible. In a system given us by Stahl, phlogiston is made the sole agent; and

the influence of air forgotten, which is, as we have seen, so powerful in most phænomena. Lavosier, on the other hand, has proved, as you have already seen, that a portion of air combines with bodies that are either calcined or burned; and hence another class of chymists hath arisen, who have began to doubt of the presence of phlogiston, and who attribute to fixity, or disengagement of air, all the phænomena, which Stahl held to be owing to the combination, or separation, of phlogiston. "Upon this subject," says Fourcroy, "it must be confessed, Lavoisier's doctrine seems to have the advantage of Stahl's." But, in opposition again, or more properly speaking, in assimilation with all, M. Macquer thinks, that all the phænomena of chymistry cannot be accounted for by the principle of gaz, without at the same time admitting that of phlogiston; and therefore, he has substituted in the room of phlogiston, the matter of light. And yet, it has not been decisively demonstrated, that light is present in any of the bodies, which Stahl considered as phlogistic. Thus in the age of experiments, and when the keenest researches are, in glorious emulation, proceeding in the different parts of the European world, we see that certainty is by no means as yet established, and that much

trial

trial, and much perseverance, may be still wanting in the various branches of the sciences. One object alone should unceasingly actuate inquiry, and that is, utility to mankind.

LET-

LETTER XXXVI.

WE now come to the consideration of a subject, which has perplexed the most powerful understandings, and which, though at last reduced to system, is yet perhaps defective, and not perfectly understood. The *magnet*, or loadstone, is a rich iron ore, found in large detached masses, of a dusky iron grey, often tinged brown or red, and when broken, appearing something like the common emery, but less sparkling. It is heavy, and very hard; and is generally found in places where there are iron mines. This stone was well known to the ancients. It is said to have derived its name from Magnes, a young man, who found himself supernaturally stopped by the iron nails of his shoes, as he walked over a mine. Scarcely any other property of it, however, was known, than that of its attracting iron, as we may see in Pliny. It appears, indeed, that they knew something of its communicating virtue, not only as it has been mentioned by Pythagoras and Homer, but particularly by Plato, in his description of that celebrated chain of iron rings,

rings, the first of which was held by a magnet; and by Lucretius, who makes mention of the same magnetic quality, operating through the hardest bodies. But, we do not see by any passage in their writings, that they knew any thing of the directive virtue of the loadstone: and we are utterly in the dark as to the time this discovery was first made; as also, when it was applied to the use of navigation. There is some reason to suppose, that this property of the loadstone was known earlier than the year 1180.

The loadstone is an extraordinary fossil, possessed of the most useful, yet most singular property in nature. It attracts and repels iron; but, as it was supposed till lately, no other body, except it be of its own substance. It has, however, been doubted, whether magnetism is a property inherent in iron only, and whether it be incommunicable to all other possible metallic substances. To *nickel*, we know, it is communicable; and further, that *nickel*, when purified as much as possible from iron, not only becomes more, instead of less, magnetic, but that it even acquires what iron does not, the properties of a magnet.* Cronsted is, however, decided in one opinion upon the subject. He says, "the magnetic

* Kirwan.

netic power is not innate even in the iron itself." He affirms it to be drawn into the metal by degrees, that it may vanish, is to be expelled, and may again be collected from the common receptacle, the air In every loadstone there are two parts, called its poles, from one of which issues an attractive, from the other a repulsive power. Every magnet, therefore, is in the center of a magnetic vortex, or atmosphere, of its own power; and when in a condition to move freely, will place itself in one and the same position with respect to the points of the compass, for years together, without any sensible alteration. Nothing can affect the needle, that is invisible, but magnetism. Thus, from the universality of this magnetic influence, we might, in some degree, be warranted in conjecturing, that we are environed by no less than four atmospheres; one of æther, another of electricity, a third of air, and a fourth of magnetism.

But, to be more particular, with respect to this extraordinary substance. Its primary qualities are, 1. Its poles, as I have just mentioned, with their attraction and repulsion, which are communicated very copiously by touch. 2. A piece of iron so touched, and nicely suspended, will be determined to settle itself in a direction

direction nearly north and south. 3. The end of a needle, touched by the south pole of the magnet, will turn towards the north, and *vice versa*. 4. Needles touched by the magnet, will dip below the horizon, or be directed on the touched part, to a point within the earth's surface. 5. This virtue may be also communicated to iron, by strong attrition all one way. 6. Iron rods, or bars, acquire a magnetic virtue, by standing long in one position. 7. Fire, by making the loadstone, or iron, red hot, totally destroys this virtue. 8. This power is exerted sensibly to the distance of several feet. 9. It is sensibly continued through the substances of several contiguous bodies, or pieces of iron. 10. It pervades the pores of the hardest body. 11. It equally attracts the iron in *vacuo* as in open air. 12. The poles of a magnet may be changed, by applying them to the more vigorous parts of another. 13. The communication of the magnetic virtue, does not sensibly impair that of the loadstone, though it has been observed, that some magnets, from the impurity of their masses, have communicated a greater power than they had themselves. As to the activity of the attraction, and repulsion of magnets, some extend their powers fourteen feet, and others not more than nine inches. The

sphere

sphere of their activity is also greater on some days than on others. The attraction of iron by the magnet, is greater than that of a magnet by a magnet.

From these, the sensible properties and phænomena of the loadstone, let us try if we can ascertain how they are produced, and whence we may deduce their origin. A great variety of hypotheses were formerly framed upon this subject. But that most generally admitted, is the hypothesis of the very learned and sagacious Dr. Halley. That able man supposed the globe of the earth to be one great magnet, having four magnetical poles or points of attraction, near each pole of the equator, two; and that in those parts of the world which lie adjacent to any one of those magnetic poles, the needle is chiefly governed by those poles, the nearest pole being always predominant over the more remote one. Of the north poles, that which is nearest to us, he supposes to be in the meridian of the land's-end of England, which governs the variations in European Tartary and the North Sea; the other he places in a meridian passing through California, about fifteen degrees from the north pole of the world, which governs the needle in North America, and the oceans on either side. In like

manner he accounts for the variations in the southern hemisphere. This system was ingenious, especially in its developements. * But, it has long been dropped as too visionary.

From imaginary speculations, therefore, it now comes generally to be believed, that the magnetism of the earth arises from the magnetism of all the magnetic substances contained in the earth, and blended with other bodies. The magnetic poles of the earth may be considered as the centers of the polarities of all the particular aggregates of the magnetic substances; and these poles must change place, relatively to the surface of the earth, according as the particular aggregates of magnetic substances within the earth, are in some manner or other altered, so as to have their power diminished, increased, approached, or removed from the principal poles. In regard to the variation of the needle, in England we may suppose it one degree in every seven years; and more or less in other parts, according to circumstances. But, with respect to the dipping, that is not so easily accounted for. Captain Cooke, in the southern hemisphere, had the dipping needle almost perpendicular; and consequently, we may venture to suppose that

* Philosophical Transactions, No. 148.

that he was at, or at least was very near, the southern magnetic pole. For, in a familiar instance, take a bar properly imbued with the magnetic virtue, and move a small needle in a frame upon the surface of it; the needle, as it approaches the extremities, or poles, will assume a perpendicular direction; but, when in the center or equator, its position will become horizontal.

Beccaria, indeed, with that sublimity of genius for which he has been so justly celebrated, observing that *lightning* gave polarity to the magnetic needle, and to all bodies that have any thing of iron in them; and further observing, that from the positions in which they lie, it was to be ascertained with the utmost certainty, in what direction the stroke had passed, boldly conjectured, that a regular and constant circulation of the whole mass of the fluid, from north to south, may be the original cause of magnetism in general. That this etherial current being invisible to us, he conceives to be no proof of its non-existence, since we ourselves are involved in it. This current, he would not suppose to arise from one source, but from several, in the northern hemisphere of the earth. The aberation of the common center of all these currents from the north point, may be the cause of the variation

of the needle; the period of the declination of the center of the currents, may be the period of the variation; and the obliquity with which the currents strike into the earth, may be the cause of the dipping of the needle; and also why bars of iron more easily receive the magnetic virtue in one particular direction, than in another.

That magnetism is in certain cases produced by electricity, is very true. Doctor Franklin proved particularly, by electricity, the effects of the reversal of the poles of magnets, as caused by lightning. Yet, notwithstanding this, and that there is, it must be confessed, a surprizing analogy between electricity and magnetism, they virtually seem to be two very different powers in nature. The power of electricity is of two sorts, the positive and the negative; and it is an invariable law, that bodies possessed of the same sort of electricity repel each other, whereas those which are possessed of different electricities, attract each other. Thus in magnets, there is a north and a south pole; those parts of magnetic bodies which are possessed of the same polarity, repel each other; but those which are possessed of different polarities, attract each other. One sort of electricity cannot be produced by itself, but is always accompanied

companied by the other. In the same manner, the magnetic poles are always together; nor was there ever a ferruginous substance produced which had one polarity and not the other. The electric virtue can be retained and confined by certain bodies, as glass, amber, resin, and others called electrics; but it easily pervades other substances, called conductors, or non-electrics. The magnetic virtue is retained by ferruginous substances, especially those of a hard nature, like steel; but it pervades easily, and without the least perceivable impediment, all other sorts of substances.

But, on the other hand, the magnetic power differs from the electric; first, in its not affecting our senses with any light, smell, taste, or noise; secondly, magnetism attracts only iron, (nickel excepted), or those bodies which contain some of that metal, whereas the electric power attracts bodies of various denominations; thirdly, the electric virtue is supposed to reside on the surface of electrified bodies, whereas the magnetic is quite internal; lastly, a magnet loses nothing of its power by communicating its strength to other substances; but an electrified body loses part of its electricity by electrifying other substances. These differences, therefore, shew that

these two powers, if not entirely distinct, are yet in very essential properties dissimilar.

The power of the loadstone on the face of the globe, is affected by a variety of circumstances. Thus, it is increased by cooling, by a regeneration of iron, or phlogistication of its calx, and by the action of acids upon iron It is diminished by heating, and by the decomposition of iron. Hence, these, together with volcanos, earthquakes, &c. alter the direction, or polarity of the needle. "On this account," says De Saussure, "I tried if the loadstone had not a different direction on the tops of mountains from that on plains; and if its attractive force did not diminish, like that of gravity, on receding from the earth. The result was, the needle continued precisely in the same situation, and I consequently thence concluded, that the magnet preserves the same direction on the summit as in the valley. When it is otherwise, it must be supposed to arise from iron in some parts of the mountains; or from the greater, or less dephlogistication of the ores, or the stones in which it is contained."

Many philosophers have supposed the existence of a magnetic nucleus; of the earth's containing

ing a prodigious spherical mass of loadstone in its center; and that the variations of the needle may be occasioned by the variations which the magnetic substance undergoes by earthquakes, and other subterraneous phænomena. * But this can never be ascertained; and as an hypothesis, it is attended with many difficulties. We shall, therefore, abide by the more simple explanation; and shall only just remark, that the application which is made of the loadstone to navigation; the incessant occasion which sailors have to consult it as a guide; the visible language which it speaks, and which makes it a supplement to the language of the heavens, is most wonderful and sublime.

* Æpinus.

LETTER XXXVII.

FROM all that has thus far appeared; from the general texture of bodies; and from the penetrating energies of the several elementary fluids, it would seem to be demonstrable, that there is no substance perfectly solid in nature. Even gold itself, the heaviest of all substances hitherto known, excepting platina, is perforated with invisible pores, to the amount of one half of its bulk, as has been conjectured by Newton. Hence we may form some judgment of the vacuities of other bodies: the internal structure of which, indeed, may be compared to a spunge, though the apertures cannot in general be perceived.*

Where then is the impenetrability of matter? Father *Boscovich* denies there is any such thing; and though he does not go quite so far as to expel all body out of the universe, he thus robs it of one of its most substantial qualities. The same hypothesis occurred to Mr. *Mitchell*. Matter, according to these philosophers, is an aggregate

* Bergman.

aggregate of physical points, endued with powers of attraction and repulsion, taking place at different distances; that is, it is surrounded with various spheres of attraction and repulsion, in the same manner as solid matter is generally supposed to be. If the degree of velocity therefore, or the momentum of any body in motion, be sufficiently great to overcome any of those powers of repulsion it may meet with in any other body that opposes its passage, it will find no difficulty in making its way through that body; and this even without moving the particles of that other body out of their place. On these grounds, the solidity or impenetrability, and consequently the *vis inertiæ* of matter, must be supposed founded on superficial appearances.

But Mr. Mitchell, in his Treatise on Earthquakes, is still more explicit. He says, the compressibility and elasticity of the earth, are qualities which do not shew themselves in any great degree, in common instances. On this account, few people are aware of the great extent of them. In some measure, however, they may be collected from the vibration of the walls of houses, occasioned by the passing of carriages in the streets next to them. Another instance

instance may be taken from the vibration of steeples, occasioned by the ringing of bells, or gusts of wind: not only spires are moved very considerably by this means, but, even strong towers are made to vibrate several inches, without any disjointing of the mortar, or rubbing of the stones one against another. Now this could not happen, says he, without a considerable degree of compressibility, and elasticity, in the materials of which they are composed.

Of this, however, we shall afterwards have occasion to treat more particularly. All the parts of nature are indisputably connected; air, water, earths, plants, minerals, animated and inanimated substances, are all linked together by some correspondence between causes and effects: every being in the universe is related to some other, and operated upon by it; and thus there cannot be a doubt but that nature is in continual action, and that her springs are as powerful under our feet, as they are over our heads. But, though the characters of nature are thus legible, they are not, as you perceive, so plain, as to enable those who run to read. Caution and discrimination must guard the inquirer. We must not attempt to fly, when we can scarcely pretend to creep. In considering a complex

a complex question, we must examine every distinct ingredient in the composition; and reduce every thing to its elementary simplicity. The condition of the human understanding, binds us to a strict law, and to very narrow limits. But unfortunately, it is an easier and a readier way, to consult one's own ideas—and here I am very far from alluding to the two very respectable philosophers I have just mentioned—than to attend to the operations of nature. Phænomena, indeed, accumulate on phænomena, but the eager man feels them only in the extent of his own feeble powers of explanation. Beyond the measure of his own understanding, he scarcely deigns to cast a consideration. Ignorant of the cause, he yet would generalize as the Almighty Fabricator of the Universe. How rash and hazardous the folly! In the disposition to sound philosophy, how infinitely more wise, to confess the small extent of our acquisitions; and soberly to proceed from the principle of, I know nothing, to the more enlightened point of experiment, and certain observation! What awe in the contemplation of the energies and the laws of material and immaterial existence; of the generation and the destruction of those things, that appearing merely for an instant on the stage of this

this world, are yet joined by indissoluble ties, to those which have had being, and to those which shall in futurity have form,—combining together the eternal energy and chain of the operations of nature.

The phænomena, and diversities of this terraqueous globe, have in general been supposed to depend upon three fundamental principles. The first, an universal power, energy, or spirit, which is the divine agent or efficient principle, by which the whole mass of matter in the earth is actuated, agitated, and kept in constant motion. The second, an universal power of vegetation, by which all bodies in the earth increase in bulk, and grow from small to great. The third, an universal plastic power, whereby every body in nature receives its peculiar and specific form, and such a texture and consistence, as makes it different from every other body. Thus, in regard to the first principle, we find a genial warmth in the earth, and all its parts, solid and fluid: now, there can be no warmth in any thing where there is not motion: for it is motion which excites the sensation of warmth or heat. Matter, as we have already seen, is in itself absolutely inert, or inactive, and is put in motion: therefore, motion must be

be communicated from some external agent. But we find warmth and heat in all parts of the earth, more or less. This proves, that all parts are more or less in motion, and consequently, that there is an universal agent, or spirit, or divine power. Hence, those wonderful phænomena of hot springs, and the fire and flame of volcanos, together with the constant perspiration of the earth, and of animals and vegetables.

The various materials of which the earth is composed, naturally ferment more or less, and of course warrant the conjecture, that there is a constant motion in the earth, from the central parts towards the surface. Witness, the constant supply of fuliginous and inflammable matter to volcanos, through all ages of the world, together with all the other innumerable phænomena of volcanos. In regard to the second principle, we see that all kinds of spar grow and increase in bulk, by peculiar juices and surrounding fluids. We see crystals, efflorescences, even metals, talks and asbestos, growing from stony substances, or an earthy root. Metals of all kinds grow in their proper earths. Silver, discovers as perfect a vegetation in branches and leaves, as fern itself can do. The like takes place, with diversity of manner,

in

in substances of every denomination, which shews the existence of an universal power of vegetation. And in regard to the third principle, we are to understand that immutable power, which in the beginning gave birth to the beautiful order and frame of the mundane system: to that regularity, distribution and distinction, which is to be observed eternally permanent; and at all times uniformly the same, amongst all the myriads of different kinds, and species of beings and bodies.

To each individual, therefore, of each class, there must be appropriated a means for its union and preservation; an ærial, ætherial, or electrical substance. And on the other hand, a menstruum for its separation or dissolution. Thus, say chymists, when the spirit in water begins to heat and ferment the fluid, we soon find an eager taste, which we commonly call an acid. The acid causes a precipitation of the earth with which the water was impregnated; and the more eager and heated it is, the more it precipitates. Thus all sublunary substances, as well in the class of animals as in those of vegetables and minerals, have a volatile spirit or subtile fluid, which makes part of

of their combination, and is liable to be dispersed.

Chymists were long of opinion, that all spirits may be deduced to a perfect similarity, or sameness, from whatever subject they are produced, and that they are to be converted into one another. This *alcohol*, or spirit, reduced to the utmost degree of purity, is, as Dr. Shaw expresses it, a liquor *sui generis*, and possessed of many peculiar qualities, as 1. When absolutely purified, it is an uniform and homogene liquor, capable of no farther separation, without loss or destruction of some of its homogeneous parts. 2. It is totally inflammable, leaving no soot, nor any moisture behind. 3. It has no peculiar taste nor flavor, any more than pure water, except what is owing to its nature as alcohol, or perfectly pure spirit. 4. It is an unctuous and crispy fluid, running veiny in the distillation, and its drops rolling on the surface of any other fluid, before they unite. 5. It appears to be the essential oil of the body it is obtained from, broken very fine; and intimately and strongly mixed with an aqueous fluid, which is assimilated, or changed in its nature in the operation. 6. And lastly, it seems to be a kind of universal fluid.

As

As this spirit therefore, was looked upon as an essential part of all substances, so was an *alkahest*, or universal solvent, said by Paracelsus, and the elder Van Helmont, to be in nature, that which was capable of dissolving all bodies; and of reducing them, whether homogeneous or mixed, into their *ens primum*, or original matter whereof they were composed. But this was extravagant and visionary; to the full as absurd as the building of a world. The real philosopher, as we have often observed, shuns such illusory ideas. He neither demands how the world exists; attempts to penetrate the reason of its existence; the æra of its birth, or the mode of its dissolution. To him it is sufficient, if he can but trace and consider a few of its phænomena; if, in his inquiries, he can but find out a link in the chain of causes and effects; or if, in the contemplation of the mighty fabric, he can but form probable conjectures on a few of the laws by which it is regulated.

Our globe is indisputably, both internally and externally, irregular. It projects with mountains, and is dug into caverns. Its surface is unequal, and its inner parts are variegated. The alterations it has undergone, have been manifold.

manifold. To a few evident causes, however, they may in general be attributed, though they cannot in any manner be proved. First, to heat, which melts, volatilizes, mixes, combines, calcines, vitrifies, and consequently gives birth to fiery eruptions. Secondly, to water, which may be said to be the most universal, as it searches every where. Thirdly, to air, which by its currents, forms the winds, which, pent up in carverns, and rarefied by heat, burst through every thing that opposes them; break out caverns and open those mouths, whence issue forth inevitable destruction. And fourthly, to substances of a saline nature, which greatly assist inflammation.

Beyond this, it is chimerical to go. We cannot comprehend, says Aristotle, the integral parts of nature. Those who have pretended to that knowledge, have only exhibited weakness and contradiction. To explain the properties of fire, some have said, the parts must be pyramidal; others obeliscal; others spherical. All we can arrive at, are the apparently certain elements, which have in themselves an inherent property of motion and of rest. Thus, says he, material earth tends towards the centre; water rises above

the earth; air above the water; and fire above the air. The intermediate water and air, hold only a relative place, being more light than earth, but more ponderous than fire.

LETTER XXXVIII.

AFTER a long journey, wherein we have unavoidably been obliged to look with more than common attention, at each of the elementary features of nature, we at length get to a point, whence the whole collective force is to be viewed; and where even in the pride of present beauty, former discord, and the rage of contending elements, are to be observed in their most hideous forms. The glory of light, and the energy of fire, have amply been displayed before us. The creative powers of the waters, have likewise manifested themselves in our examination. But, we are now to contemplate nature as undergoing an awful change. The agents of existence, we shall now find the engines of destruction. That which warmed the hearts of mortals with the liveliest throbs of gratitude, now shall appal them with terror and apprehension. Instead of life, we shall have death. Instead of harmony, we shall have convulsions and desolation,

The combustible matters in nature, are divided into five kinds, independent of phospho-ra, which might be added. The diamond; the inflammable gaz; sulphur; metallic substances, and bitumens: and all have the same property of burning, when roused by the contact of air. There are three sorts of combustion. With flame and heat as sulphur; without flame as many metals; and with flame but without heat, as phosphorous. The diamond, of all these, is the most infusible, most fixed, most transparent, most divested of smell, and is perhaps the body most inflammable that is known; as it burns entirely away, and leaves no residuum. Sir Isaac Newton called it a coagulated inflammable substance. But diamonds, which in fact seem to be no other than particles of light, bound up in adamantine chains, from their apparent resemblance to crystaline, and vitrifiable stones and gems, were universally held by naturalists, not to be different in their constituent matter from such stones and gems, except in a greater degree of purity. Newton, however, judging by their refractive power, classed them with inflammable bodies; and held, that they consisted of the purest phlogiston; but according to the custom of his time, he used the words sulphurous, unctuous, &c. to signify what

what later chymical writers express by the terms phlogistic, or hydrogenous: he accordingly says, a diamond is probably an unctuous substance coagulated. From experiment indeed it appears, that diamonds are the only natural substance, in which phlogiston appears to exist pure and unmixed. * For all inflammable liquors contain water: and all solid inflammable bodies leave a residuum of ashes or coal. Diamonds dissipate and totally disappear, while the ruby and the other gems sustain the operation of heat without damage. † Thus, from their native form and constituent matter, they may probably perhaps be defined crystalized phlogiston.

The opinions of philosophers have varied with the varied revolutions of science; and they have scarcely ever long together held to the same point. Thus, they have differed as to the formation of combustible matters. It at length, however, seems to be generally believed, that those even in the bowels of the earth, such as coal and bitumens, are the product of organized bodies which have vegetated on the surface of it. Many proofs might be adduced, that pit-coal in particular, is composed of the spoils

* Delaval. † Bergman.

of vegetables, blended with bitumen and sulphur, or rather the vitriolic acid. And bitumens may reasonably be supposed, to have originated from subterraneous fires existing near strata of coal, and there dissolving the coal, giving rise to bitumenous sources.

Bitumens, says Fourcroy, are combustible substances, solid, soft, or fluid; whose odour is strong, sharp, aromatic, and who appear to be a great deal more compounded than the bodies of the mineral reign. There are, however, diversities of opinion on this subject. Some think these combustible bodies belong to the mineral kingdom, and that they are to minerals, what oils and resins are to organic bodies. Others, and apparently with the most reason, insist that they proceed from organic substances, that is, animals and vegetables. Thus the successive beds of bitumens that are found in the bowels of the earth, announce them to have been deposited slowly, and by the waters. By the lapse of time, by saline or by other substances, they are indurated. The oils, and fat of marine animals, seem to have been one of the compositions used by nature to produce certain of them; while in the origin of others, the oils and resin of vegetables are palpable. Those

beds

beds of coal, says Romé de l'Isle, which form the greatest part of the bitumenous beds that have been yet discovered, are nothing but ancient deposits in the *sea*, or masses more or less considerable, of animals and vegetables, which, by the action of the vitriolic or marine acid on the oil, or fat matter of these substances, have become by degrees converted into bitumens.* These oils have sometimes been simply interposed in the substances, which have given them birth, and hence turf; sometimes they have flowed into cavities, and being modified by an acid, have passed into a state of bitumen, transparent or opake, as is observable in amber and jet; which former, in Prussia, is commonly found under a bed of turf, both being nearly of the same substance.† The name of oil, by the way, by common consent, being given to that fat unctuous substance, which appears to belong exclusively to animals and vegetables. Six bitumens are known. Amber, asphaltum, or the bitumen of Judea, jet, coal, ambergris, and petroleum.

Amber is the most beautiful of all the bitumens. *Sophocles* poetically affirmed, it was formed in India, by the tears of the sisters of

* Pallas. † Démeste.

Meleager, changed into birds, and deploring the fate of their brother. Others, that Phaeton, burning the heavens and the earth, was precipitated by the thunder of Jove into the waters of Eridanus. There his sisters wept; and the precious tears falling into the waters but not mixing with them, became solid without losing their transparency. It is capable of a fine polish. When it is rubbed for some time, it becomes electric, and attracts straws and other light bodies, as we have already observed. It has been erroneously classed among the precious stones. The insects that are often found in it, prove it was once liquid. It is probable that amber is derived from a resinous juice, which flows from certain trees; and which, buried in the bowels of the earth, from the shocks the globe has experienced, there becomes impregnated with certain mineral and saline particles, and is consequently hardened. Other opinions, indeed, would fix it a solid mineral bitumen, not a vegetable resin, or inspissated juice, introduced into the cavities of the earth, and there indurated, and somewhat changed in its quality. They likewise would establish it an unequivocal terrene substance, though it is not unfrequently found in the sea.

The

The asphaltum, or bitumen of Judea, called also the gum of funerals; the karabé of Sodom; mountain pitch, balm of mummies, &c. is black, not very weighty, solid, and but little brilliant.* It breaks easily, and like a vitrification. While cold, it has no odour. It is found on the waters of the lake Asphaltus, or dead sea in Judea, near to the situations of the ancient cities of Sodom and Gomorrah. It is found also in other places. Its origin is supposed the same with the amber bitumen. Jet, called by the Latins gagas, and by Pliny named black amber, is a black, compact, hard bitumen; brittle and vitrificacious in breaking. Rubbed for some time, it attracts light bodies, and appears electric, like amber. Oil is got from it by distillation. Among the varieties of opinions, the most probable as to its formation is, that it originates like amber, and hardens by lapse of time.

Coal, is a black bitumenous substance found in the bowels of the earth. It lies generally in horizontal beds. Above this bitumen, beds of shells and fossil madrepores are frequently found. This has made naturalists generally believe, that coal has been formed by the deposition

* Fourcroy.

sition and acervation of oily, greasy parts of marine substances. There are different kinds of coal; one kind, remains black after its combustion; another gives spungy substances like scoria; and another, fibrous, as wood, is reduced to cinders. Coal yields a sulpurous smell, only when it contains pyritæ.* It contains an abundance of oil. It yields an abundance likewise of volatile alkali, which favors the opinion of its organic origin, as it is proved, that all animal bodies afford in distillation a salt of that nature.

Ambergris, is a concrete bitumenous substance, of a soft though tenacious consistency, like wax. It appears evidently to have been in a fluid state, from the number of different things found in it, as the heads and feathers of birds, bones of fishes, &c. It is found floating on the sea. There is much difference in opinion relative to ambergris. Some believe it to be a sort of petroleum, which runs from rocks, thickened by the action of the sun and of salt water. Others conceive it to be the produce of an animal, viz. the excrement of birds who live on odoriferous herbs; or an inguinal secretion in whales, in whose stomachs it is often found. To the whale,

* Fourcroy.

whale, the cow whale in particular, it certainly belongs; and though said, either to be the cause or effect of disease, may be classed with such animal juices as the musk and the civet. Three hundred and sixty ounces of ambergris have been found in one whale; and on analyzation it has been proved to have the same principles as other bitumens, that is to say, an acid spirit; a concrete acid salt; an oil and a charcoal residuum; and therefore, it is ranked as a bitumen.

Petroleum, is a liquid bitumen which runs between rocks and stones. It is distinguished into varieties. The lightest, most transparent, and most inflammable, is called naptha. The heavy, black, thick and tenacious, so as to stick to the fingers, is the petroleum. The pissasphaltum, is of a consistency between the common petroleum and the asphaltum, or bitumen of Judea.

The bowels of the earth, we thus see, are replete with combustion and inflammable substances. They do not, as philosophers supposed, terminate in a clear, crystaline fountain, in which there is nothing to be tasted but the waters of life. On the contrary, every thing would

would seem to prove, they are like the stomach of an animal, in which is constantly flowing all sorts of impurities. From the earth, therefore, we preceive, there is something like an analogous perspiration, which, when regular, passes off like insensible perspiration in an healthy body; but, when obstructed, or increased to a violent degree, produces effects similar to those of a febrile heat in the body; and a concussion ensues, which commonly is succeeded by a vast effusion of watery vapours, and great falls of rain, similar to the profuse quantities which break out from the human body after a shaking fit. Two observations confirm this; first, that earthquakes are commonly preceded by a great drought, and a series of fine weather: and secondly, that they are succeeded by great rains.

But the cause of the internal commotions of the earth, or rather the origin of the fires which occasion them, is not easily explained. It is well known that martial pyritæ being moistened, will acquire heat; but, that this heat may burst into actual flame, the concourse of open air is absolutely requisite: however, if we suppose the heated pyritæ to have been in contact with black wad and petroleum, we may suppose the flame to arise, as we see it produced by art, in the

the desiccation of that substance, and its mixture with the mineral oil.* That ore, when heated, affords dephlogisticated air, of which a very small quantity is sufficient to produce flame: This flame once produced, may be supported by dephlogisticated air from other ores; and the phlogiston may be supplied by pyritæ, bitumenous schistus, bitumen and coal.

The existence of subterraneous fire, therefore, may readily be explained in our present state of knowledge relative to dephlogisticated air, since we can easily imagine, that much dephlogisticated air may be detached from variety of bodies within the bowels of the earth, by means of heat; and that such dephlogisticated air, will serve to keep those very fires burning, which are the instrumental means of its production from the divers minerals which contain that pure respirable fluid.† This indeed, Lavoisier, as we formerly remarked, has demonstrated, in employing vital, or dephlogisticated air, instead of common air, as aliment to fire. By this means he succeeded in melting platina. Glasses had often been used, and had produced remarkable effects, in fusing bodies that had long been deemed infusible or refractory. But Lavoisier's method proved, that dephlo-

* Kirwan. † Cavallo.

dephlogisticated air augments the activity of heat, and manifests the power of fire, in the most eminent degree.

The inflammable bodies which we have thus mentioned, and which are supposed to have generated in a long period of time, from animal and from vegetable substances, meeting with acids and other substances in the bowels of the earth, and there undergoing various changes, until they acquire the form in which they present themselves to us; are still capable of further corroboration, from the great chymical difference between the mineral and the organic kingdoms. Vegetable and animal bodies furnish an inflammable fat, or oily substance. Mineral bodies are unfurnished with such substance. And hence it is, that animal bodies are susceptible of fermentation, while mineral bodies are not so. And yet a sort of doubt, in one particular instance, is thrown upon this hypothesis. All strata, accompanying coal, says *Whitehurst*, are universally charged with vegetable forms, which plainly indicate, that all coals were originally derived from vegetables. But may not the same be said of iron, for the same strata, also produce iron stone; and wherever vegetables are observed to decay

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in stagnant ditches, the waters in the ditch appear ochrey? It is worthy of notice also, that superior strata universally contain iron stone, coals, and vegetable impressions, but no marine production whatever; whereas *inferior* strata, which are lime stone, contain the exuviæ of marine animals, but no vegetable forms. An extraordinary bed of coal, likewise, near the village of Ninkerich, belonging to the Prince of Sarrebrück, begins at the side of a mountain, at the height of 200 feet from the plain, and continues upwards. The vegetable remains which are in and about it, are prodigious.

But this is a subject which we must examine a little more closely. Vegetables, as I have above said, have been considered as the cause of the formation of pit coal. A few forests, however, being buried in the earth, are not sufficient to form the masses of coal which exist in its bowels. A greater cause, more proportioned to the magnitude of the effect, is required; and we find it only in that prodigious quantity of vegetables which grows in the seas, and is still increased by the immense mass of those which are carried down by rivers. These vegetables, carried away by the currents, are agitated, heaped together, and broken by the

waves;

waves; and afterwards become covered with strata of argillaceous, or calcareous earth, and are decomposed. Nor is it more difficult to conceive, how these masses of vegetables may form strata of coal, than that the remains of shells should form the greater part of the globe. The direct proofs which may be given in support of this theory, are, as I have already mentioned, the presence of vegetable and marine substances. The soils which contain coal, are generally of schistus or grit; and as the formation of *pyrites*, as well as that of coal, arises from the decomposition of vegetable and animal substances, for sulphur has been proved to exist naturally in certain animals and plants, all pit coal is more or less pyritous; so that we may consider pit coal as a mixture of pyrites, schistus, and bitumen. The different qualities of coal, arise, therefore, from the difference in the proportions of these principles. The best is that in which the bitumenous principle is the most abundant, and exempt from all impurity. *

It has been conjectured, that the strata of coal keep their course, in general, in a line of bearing quite through a country, and perhaps round the whole globe. Thus it is asserted, that coals stretch away under the mountains, and emerge

* Chaptal.

emerge again upon the opposite side. But better observation makes it now evident, that coal countries are but patches of limited, though different dimensions; and that coals were among the last formed of the strata of the globe. It was likewise for a long while supposed, that the smell of pit coal was unwholesome. M. Venel has, however, made many experiments on this subject, and is convinced that neither man nor animal is incommoded by its vapour. *Hoffman* relates, that disorders of the lungs are unknown in the villages of Germany, where this combustible only is used. And this, indeed, may all be true of coal of a good quality, which does not emit any dangerous vapour; but, when it is pyritous, its smell cannot but be hurtful. How long this fossil may have been known in the world, it is immaterial to inquire. It is given by historians a very modern date, although it is probably considerably older. In the east, in China in particular, there are grounds for believing it was discovered long before it was known in the western world. However this may be, this magazine of combustible matter, which gives men time to repair their exhausted forests, has not been used even in London above 200 years. Nor is it yet admitted even for culinary or domestic purposes

on many parts of the continent, although almost every part abounds in coal mines. Nor though tar is copiously to be extracted from coal, which by the way is another strong proof of its vegetable origin, are we to confound pit coal with charcoal, or what is called carbone in the new French nomenclature, which nevertheless exists ready formed as sulphur, in vegetables and animals.

LETTER XXXIX.

WE have seen that water, by its dissolving virtue, and by its fluidity, tends to level the surface of the globe over which it runs; and that it again, by assembling the bodies so carried off, into its bosom, throws off a renovated form, and ultimately produces great and surprizing inequalities. In like manner, beneath the earthy surface of the globe, we shall be able to trace its levelling and its dreadful energy. Below, as strikingly as above, we shall observe the effects of its penetrating and destroying qualities. So universal has been its devastations, that one might be almost tempted to say with Leibnitz, and in the words of the old philosophy, there is no such thing in matter, as parts permanent and solid.

The conjoint operation of fire and water is tremendous. Fluids, you know, are raised to a boiling state, when the matter of fire passes with such rapidity and force through their substance, as to be superior to the pressure of the

air upon their surface; and when this point is gained, the fire having nothing further to resist it, the heat never rises higher; so that all fluids have a certain fixed degree, at which they boil. Water will not boil (except in some particular cases) but with an heat of 212 degrees. Yet, when the pressure of the atmosphere is almost entirely removed in the vacuum of an air pump, water will boil with an heat not exceeding 95 degrees, or 117 degrees below the heat required in the open air: and hence it appears, that fire and air act as antagonists in the operation of boiling.*

Water in vapour, occupies 1400 times more space than in fluidity; and by the same degree of heat is rarefied 14,000 times, while air is only rarefied two thirds.† Its spring and elasticity, consequently, are such as to produce dreadful explosions when pent up. Even in mechanics, we see it is used to move the heaviest bodies. It favors combustion, and hence Boerhaave looked upon flame to be principally formed of water. At Geyser, in Iceland, says *Van Troil*, one sees within the circumference of three miles, forty or fifty boiling springs together, which seem to proceed

* Philosophy of the Elements. † Philosoph. Transact.

proceed all from the same reservoir. In some the water is perfectly clear; in others, thick. The water spouts up from all, some continually, others at intervals. The altitude of one of these spouts, measured by a quadrant, was ninety-two feet. The force of the vapours which throw up this water, is excessive; it not only prevents the stones which are by way of experiment thrown into the opening, from sinking, but even throws them up to a very great height together with the water.

But, if while acting by itself it is thus powerful, how irresistible must it be, when it comes in contact with metals in fusion in the bowels of the earth. An explosion then immediately takes place, and the parts of the metal are scattered in all directions. The force with which this steam can act, is indeed wonderful. About 60 years ago, during the operation of casting some brass cannon, in the presence of a number of spectators, the heat of the metal of the first gun drove so much damp into the mould of the second, which was near it, that as soon as the metal was let into it, it blew up with the greatest violence, tearing up the ground some feet; breaking down the furnace, unroofing the house, and killing many people on the spot.

Thus, as it has been related, the explosion was like thunder; and the force was equal to the noise; for the matter was scattered by the blast, as dust would be before the wind.

So apparent a reason for some of the phænomena of nature, did not fail to strike the minds of reflecting men, and to point out to them the way of satisfactorily explaining difficulties of no inconsiderable stubbornness. It is found by experience, says *Burnet*, that water, so gentle in itself when undisturbed, flies, when it falls amongst liquid metals, with an incredible impetuosity, and breaks, or bears down every thing that would stop its motion and expansion. This causes the marvellous force of volcanos, when they throw out stones and rocks. This explosion, made by the sudden rarefaction of sea waters, which fall in receptacles of molten ore, and ardent liquids within the cavities of the mountains; and thereupon, follow the noises, roarings and eruptions of those places. Volcanos, says he, are always in mountains, and generally, if not always, near the sea; and when its waters by subterraneous passages, are driven under the mountain, they meet there with metals, and minérals dissolved, and are immediately rarefied, and, by way of explosion, fly out at

at the mouth or funnel of the mountain, bearing before them whatsoever stands in their way.

The explosion and eruption of the various matters of a volcano, proceed indeed in all probability, from the access of a large quantity of water, which either enters through some crack in the bottom of the sea, or from sources in the earth *. If the mass of water so admitted, be sufficiently great, it will extinguish the subterraneous fire; if not, it will suddenly be converted into vapour, whose elastic force is known to be several thousand times greater than that of gunpowder. But, as I have already said, the contact of water with metals is that which probably produces the most tremendous effects. If we consider the immense quantity of matter thrown up at different times by volcanos, without lessening their apparent bulk, what frightful hoards of both fire and metals, in readiness for the accession of water, must we not suppose accumulated in the internal parts of the globe. The chymical examination of the volcanic matters thus ejected, proves that iron makes from one-fifth to one-fourth of their whole substance. How enormous the quantity, there-

 fore,

* Kirwan.

fore, of this metal, or at least of the stones in which it is contained.

The sentiments of chymists concerning the causes of subterraneous explosion, have been various. As it, however, has been looked upon as analogous to the act of fulmination, which is more immediately open to our investigation, we shall for a moment advert to what has been said upon that subject. The mixture of nitre, sulphur and charcoal, composes a matter, the terrible effects of which, is owing to its great combustibility. Its greatest proportion is of nitre, next of charcoal, and last of sulphur. The effects of this mixture, or, as we commonly call it, gunpowder, is thus accounted for: sulpur and charcoal are eminently combustible: the nitre is equally distributed between the molecules of these substances, and as it is in a much larger quantity, each molecule of sulphur and charcoal is surrounded by nitre. Each then, has a greater quantity of air than is necessary for itself for inflammation; for it is known, that when heated, nitre furnishes an abundance of pure air. Thus it happens in this combustion, as it does to a combustible substance plunged into dephlogisticated air, which burns with infinitely more vivacity than before. And

hence

hence the rapidity of powder, and its explosions when opposed by any obstacle whatever. The explosive force of powder, we in this manner see, is from the blast of air in the nitre, expanded by the fire in the sulphur; and that these are more suddenly kindled and opened by the medium of charcoal. The force or energy of solid materials, are thus out of the question. It is merely the operation of a quiescent air, excited to action, and expanded by fire.

Various substances, as we have formerly observed, when heated to a certain degree, produce a great quantity of elastic fluid, and almost instantaneously; which elastic fluid, gives a concussion to the ambient air, occasioning an explosion. Hence, the impetus, or the force exerted, and the report, are in proportion to the quantity of elastic fluid produced, and also to the quickness of this production. Thus nitre yields by heat, a considerable quantity of dephlogisticated air; charcoal yields by heat, a considerable quantity of inflammable air. The fire employed to inflame the gunpowder, extricates these two airs, and sets fire to them at the instant of their extrication.* The air thus volatilized from fired gunpowder, occupies about

* Cavallo.

about 244 times as much space as when it lies quiescent in the gunpowder. The space to which this is again expanded by the heat of the flame, is about four times as much: so that the force or pressure of fired gunpowder, is about 1000 times greater than the pressure of the atmosphere, which being equal to fourteen pounds every square inch, the force of gunpowder upon the same, must be equal to 14000 pounds, which will account for the astonishing effects of cannon balls.*

Many chymists, however, have ascribed the cause of fulmination to a saline, and to a sulphurous, as well as to an aerial principle; and there are not a few, who have supposed it to depend upon several of these united. But, what we have said above, is, I believe the true solution. Yet, forcible as gunpowder may appear to us, there is yet another substance, an *aurum fulminans*, which is still more powerful. Various experiments have been made on the comparative force of these powders. The aurum fulminans, notwithstanding celebrated philosophers, such as Boerhaave, Macquer, Spielman and others, contend it is not accounted for,—is simply the calx of gold; for by whatever method gold be dissolved,

* Philosophy of the Elements.

dissolved, and precipitated (provided the volatile alkali be present either in the menstruum or the precipitant) a yellow precipitate is obtained, which, when well washed in water, and cautiously dried, is the aurum fulminans. The weight of this calx, when well washed and dried, exceeds that of the gold employed, about one fifth. A single cubic inch of gunpowder, generates about 244 inches of elastic fluid, but the same quantity of aurum fulminans, yields at least four times as much; and hence, from its copious and instantaneous eruption, and violently striking the common air, its wonderful explosive force.* The trial of this, indeed, was made by our Royal Society. Equal parts of gunpowder and aurum fulminans, were distinctly included in iron globes, and placed among burning coals. Those which contained the aurum fulminans were burst with violence, while the other remained perfectly at rest and silent. But fulminant silver, as I have before remarked to you, is still more violent than the aurum fulminans.

The knowledge of these circumstances, conducted philosophers to more applicable experiments, as to similar phænomena in nature. Accordingly

* Bergman.

cordingly it was discovered,* that mixing, for instance, twenty-five pounds of powdered sulphur with an equal weight of iron filings, kneading the mixture together by means of a little water, into the consistency of paste, and putting it into an iron pot covered with a cloth, and burying it a foot under ground, that in eight or nine hours afterwards, the consequence would be a true volcano. Hence it is natural to conclude, that the body of the earth must have various spiracula or out-lets, which, like ulcers in the human frame, discharge peccant humours; and which, frightful as they may seem to our terrified imaginations, yet serve to prevent more dreadful and destructive effects in the constitution of the globe. Ætna, Vesuvius, and other burning mountains, in this manner, it is probable, throw off their intestinal superfluities.

The causes of the concussions of the earth, were reduced by the ancients to three: water, fire, and air. Thales, who held the mosaic doctrine, that the earth is founded upon the waters, supposed that nothing more was necessary to produce earthquakes, than some irregular agitation of the waters that are under the earth. Others, seeing

* M. Lemery.

seeing that nothing can resist the force of boiling water when turned into vapour by fire, held the idea which Seneca expresses, "cum "pluribus locis ferveant (ignes) necesse est in- "gentem vaporem sine exitu volvant. Videmus "aquam spumare igne subjecto: quod multo "magis illum facere credamus, cum violentus "ac vastus ingentes aquas excitat: tunc ille va- "poratione inundantium aquarum, quicquid "pulsaverit agitat." He adds, also, that the best and greatest authors all agree, to derive earthquakes from the motion of subterraneous air. Aristotle, and Theophrastus, were of opinion, that there is a constant evaporation from the earth upwards, which, if it has not vent, returns upon itself, and is condensed, till it forces its way, and in so doing, shakes the superior parts of the earth. Even Seneca himself has one very subtle argument to prove, that air is the true cause of earthquakes: because in all cases when air makes an effort to break out, its first shock is always greatest, the air being then densest; and all the succeeding ones lessen by degrees, as the air becomes rarefied. Fire, however, does not follow this rule: its first effort is not greatest, but it rises to its ultimatum by degrees. Pliny, some years before him, was of the same opinion.

These

These opinions, on certainly the greatest and most terrible phænomena of nature, were those which alone were adopted by the generality of philosophers. But though concussions might have been extended, even though, for instance, a violent eruption of Mount Ætna might have caused an earthquake over the whole island of Sicily, it yet could not, with much probability, have been supposed to have reached three or four hundred leagues distant. In order to account for this, however, it was said, that all inflammable matters capable of explosion, generate a large quantity of air; that this air, produced by the fire, is in a state of very great rarefaction, but by means of compression in the bowels of the earth, is driven to the production of these violent effects. Let us suppose, therefore, said they, that at a very considerable depth, a hundred or two hundred fathoms, there be found pyritæ and other sulphurous substances, and that by the fermentation produced by the filtrating of waters, or other causes, these happen to take fire; let us see what will be the result: in the first place, these substances are not disposed in horizontal strata; on the contrary, they are contained in the perpendicular fissures; in the caverns at the foot of those fissures, and in other places where the

the water can act, and into which they can penetrate: these substances, coming to take fire, will generate a large quantity of air, whose spring being compressed in little room, as in that of a cavern, will not only shake the superior ground, but seek for passages to escape, and to extricate itself. The passages that present themselves, are the caverns and canals formed by the subterraneous waters and rivulets; the rarefied air will violently precipitate into all the passages that are thus open, and form a furious wind in these subterraneous cavities, the noise of which shall be heard at the surface of the earth, accompanied with concussions. This subterraneous wind, produced by the fire, will extend as far as these cavities, and cause an earthquake more or less violent, in proportion as it is near or remote from the fire, and finds passages more or less narrow: this motion being performed lengthwise, the concussion will be in the same direction, and the earthquake be felt in a straight tract of ground. This air will cause no eruption or volcano, because it will find sufficient room to dilate itself, or rather, because it will find out-lets, and issue out in the form of wind or vapour: or even should it be denied, that there are actually any subterraneous passages by which this

this air, and these vapours can escape, it is easily to be conceived, that in the very place where the first explosion happens, the ground being raised to a considerable height, the adjoining place may be divided and rent asunder horizontally, in order to correspond with the primary motion, which is sufficient to make passages that may communicate the motion to a very great distance.

Ingenious as these ideas must be allowed, and true as they unquestionably are, in local and confined situations, it yet is with abundance of probability, I might even say of certainty, to be contended, that another cause, still more powerful and universal, is to be given to extended concussions of the earth. Fire, or rather vapour proceeding from the operation of fire, we have already seen capable of dreadful commotions. But the more subtile agency of the electrical fluid, has not yet been adverted to. Descartes boldly pronounced earthquakes to be shocks of electricity, and to be similar to those of thunder. The idea was great, and from experiment and analogy, seems to be confirmed. Yet, as I said before, we must not adopt it indiscriminately. To elementary fire and vapour we must ascribe what belongs to them. Electricity

tricity then will come in for its appropriate and larger share of consideration. Nor will we disunite them altogether, for there are instances, in which they operate conjointly.

Braccini observed in 1631, that a column of smoke from Vesuvius, extended over several miles of the country, from which *deadly lightning* proceeded. The same happened in 1767, when the iron rods erected in Naples became electric whenever Vesuvius emitted fire. But Dr. Stukely was the first in our country, who strenuously insisted upon it, that earthquakes are solely occasioned by electricity. In his very learned investigation of this subject, he will not allow they can be occasioned by subterraneous winds, by fires, by vapours, or by any thing that occasions an explosion, and heaves up the ground; for the operation of such a fermentation, says he, would be many days in continuance, and not instantaneous, and the evaporation of the inflammable matter would require a long space of time. Moreover, the whole system of springs and fountains would be ruined, (contrary to fact), wherever earthquakes prevail. Ships at sea are struck, as if they thumped their bottoms; even fishes are affected. The stroke must, therefore, be occasioned by some-

thing that can communicate motion with unspeakably greater velocity than any heaving of the earth under the sea from the elasticity of generated vapours. Such could only produce a gradual swell, and could never give such an impulse to water, as would make it feel like a stone. An earthquake is preceded by a warmth, and dryness of air, essentially necessary to electricity; by the Aurora Borealis, by fire balls, thunder, lightning, and coruscations.

The venerable *Beccaria*, still corroborated this hypothesis, and went so far as to say, that powerful lightning had not unfrequently occasioned, or at least been attended by shakings of the earth. But, in reality, to what other less powerful cause can we attribute the universal and almost momentary phænomena of earthquakes? The rapidity of fire, of the percussion of air, and of vapour, we clearly understand. But can the following facts be attributed to either of these? In the reign of Valentinian, there was an earthquake by which the whole known world was shaken. On the 1st of November, 1755, when the memorable earthquake happened at Lisbon, the seas, lakes, ponds, and rivers, were affected all over Europe: and strange explosions were heard by some of the

workmen

workmen in the mines in Derbyshire. * And yet at the same time, and it is a circumstance very extraordinary, that burning mountains have been observed to keep time with one another in very remote parts of the world. *Gassendus* says, there happened an eruption at the mountain *Semo*, in Ethiopia, at the same time with that of Vesuvius in 1633. The same has been observed of Ætna, Vesuvius, and Stromboli; but they being near, it is not so remarkable that they should act in concert: whereas Semo is 2000 miles from Vesuvius. On the day so fatal to Lisbon, the island of Maderia was violently shook by an earthquake, attended by subterraneous explosions; and about an hour and a half after the tremor had ceased, the sea, which was quite calm, retired suddenly, and then rushed in fifteen feet above high water mark. At Lisbon itself, the sea rushed towards the city like a torrent, though against wind and tide, and rose forty feet higher than ever was known. At Cadiz, on the same day, the sea appeared sixty feet higher than common; beat in the breast-work of the walls, and carried guns of eight and ten tons weight, forty or fifty yards from the wall. At Tangier, Arzila, Salle, and Saffe, the same phæno-

* Philosophy of the Elements.

mena were observed on the same day, though in a less degree; as they were in England, Scotland, Ireland, Holland, Switzerland, and many other parts of the continent. Similar circumstances also have occurred, at different periods of the history of the world.

Facts like these warrant, indeed, the conjecture, that concussions which in such manner stretch almost through a whole hemisphere, must have their origin in that universal fluid, electricity; while the causes of more confined ones, together with their explosions and eruptions, may be ascribed to the conjoint operation of the oceans of melted matter and water. Rarefaction and condensation (for the force of steam exceeds that of gunpowder as 14,000 is to 500), causes these partial tremors. Vesuvius often demonstrates it. In 1631, and 1698, vast torrents of boiling water flowed from the crater of this mountain, previous to an eruption of fire; and what was very remarkable, many sorts of *calcined shells* were found upon the brink of the crater, and also in the channel formed by the flood.* Do not these shells testify a present, or a former communication between these contending elements of fire and water? But, besides these more apparent instances, we frequently at sea, preceive

* Whitehurst.

perceive the effects of submarine commotions, and of strange agitations produced by volcanos, whose mouths, though many fathoms beneath the surface, vomit forth torrents of fire, sulphur and bitumen; and in the course of their raging, cause ripplings, currents, and whirlpools. But the energy, and the frequency of eruptions, are most remarkable in Iceland. The Iceland chronicles give a list of 63 eruptions at Heckla and other places, from the year 1000 to 1766; of which twenty-three were eruptions of Mount Heckla alone.* What a direful number! and yet if so many can have been computed in the space of less than 800 years, and on one fragment of the globe, how much beyond calculation must those have been, which have desolated the other regions of the earth, and the still more extended bottom of the ocean, in the progress of an Eternity!

* Van Troil.

LETTER XL.

THEORIES that are founded on observation and experiment, and are not assumed, are at least always good for so much as they explain. Our inability to push them indefinitely, is no argument against them. This inability may be owing to our general ignorance, or to a misconception of particular causes, but not to a defect in the principles we employ. Hence on this subject of earthquakes, explosions, and volcanic eruptions, the various opinions which have been started, have respectively had their distinguished merits. Yet each has been marked with its own defects. The selecting from the whole, therefore, the principles the most approved, is the only practicable method of combining them into a certain, or even into a probable system. The indisputable vestiges of volcanos are every where discernable. England, Scotland, Ireland, France, Germany, North America, the East and West Indies, the late discovered islands in the South Seas; in short, the whole face of the globe, is to be

be found covered with the palpable productions, or the evident traces, of extinguished eruptions.

The island of Iceland, as I have already observed, which is justly reckoned among the largest islands in the world, is a melancholy picture of the truth of this assertion. Every mountain, though continually covered with ice and snow, and every vale, affords the most speaking proofs of the dreadful effects of volcanos. Heckla, says Burnet, situated within the polar circle, and its neighbourhood, scarcely habitable by reason of the extremity of cold, is a fierce volcano. This mountain hath its head always covered with snow, and its belly always filled with fire; and these are both so strong in their kind, that they cannot destroy each other. When it rages, it casts out, besides earth, stones and ashes, a sort of flaming water, as if all contrarieties were to meet in this island, and to make it the more perfect resemblance of hell, as the credulous inhabitants fancy it to be. Thus there are to be observed on Heckla, in perpetual union, as on Ætna, the two elements that are at perpetual war: an immense gulph of fire, for ever existing in the midst of snow, which it has not power to melt; and immense fields of snow and ice, for ever

surrounding this gulph of fire, which they have not power to extinguish.*

These profound and bottomless chasms, indeed, may justly strike ignorance and superstition with the apprehension of infernal horrors. In them they may suppose the wicked groaning, and suffering punishment for their crimes. There, the ancients fancied those giants were confined, who in their life-times made mankind tremble. In short, it is within these roaring cauldrons, where tyrants might have been conceived to have been transported; — where they might have been imagined to have been fated to have survived their enormities, and to expiate them in the agony of flames.

These destructive mountains are the immediate work of subterraneous fire. M. Ferber says, it is a fact, that subterraneous fire, and its many successive eruptions, have raised or heaped together, the still burning Mount Ætna and Vesuvius on the lime-stone strata in Sicily and Italy, accumulating both these mountains to an amazing elevation. Recupéro still enhances the idea, when he gives us the measure of the base of Ætna, which is all formed of lava and burnt matter, and which he proves to be 183 miles.

* Brydone.

miles. But superior to the phænomena of every other volcanic mountain, are those which I have mentioned of Heckla. We undertook a journey to Mount Heckla itself, says Van Troil, and travelled about 350 English miles, over an uninterrupted track of lava.

But here it may be again demanded, why these eruptions from mountains, and not from plains? This I formerly answered, and I hope in some degree satisfactorily. The reason why earthquakes are so frequently felt in the neighbourhood of mountains, I said also, arose from the same cause, and from the cavernous situation of the soil on which these masses are reared, and which still must be rendered more hollow, in proportion to the quantities of matter ejected from the volcanos. The surfaces on which these mountains stand, were once probably plain. From an aperture in these plains, rushed the first molten matter. This accumulated. The cone then formed, and from every subsequent eruption increased in height and extension. The enormous heaps at length stretched towards the heavens; and proudly fixed themselves on their base: but the undermining hand of time, works to their destruction. At the present moment they surprize us; but the day will come, when they shall lie low.

The

The quantity of matter ejected at an eruption is almost incredible, and proves how frightful the chasms must be, which can have been formed by the tearing away such a proportion of their more solid substance. Alphonsus Borellus, a learned mathematician of Pisa, who, after the great eruption of Ætna in 1669, went into Sicily, while the fact was fresh, to survey what Ætna had done, computed, that the matter thrown out of the mountain at that time, amounted to ninety-three millions, eight hundred and thirty-eight thousand, seven hundred and fifty cubical paces. So that, if it had been extended in length upon the surface of the earth, it would have reached farther than ninety-three millions of paces, which is more than four times the circuit of the whole earth, taking a thousand paces to a mile. *

Besides those we have mentioned, and many others, the Habichwald, and adjacent Dornberg mountains in Germany, have every appearance of being volcanic. They clearly indicate,† that subterraneous fermentations, heat, and fire, worked many centuries to raise and accumulate them, by eruptions upon a calcareous marine ground, and perhaps in the midst of an ancient sea.

* Burnet. † Raspe.

sea. Ridges of a like origin, and of the same remote antiquity, are dispersed all over Hesse. Sir William Hamilton likewise traces them in other parts. He believes that Mount Vesuvius originally rose from the bottom of the sea, and his reason for it is not a feeble one; for it appears, that all the earth in its neighbourhood, throughout a very extensive circuit, is composed of different strata of erupted matter, and to a depth even below the surface of the Mediterranean. But the truth is, that sub-marine volcanos are frequent. We often, at sea, see large quantities of pumicestone floating on its surface, independent of the various other phænomena which we have already alluded to.

The vapour that occasions these eruptions, as we have before observed, has a tremendous power. The superincumbent strata, therefore, if they be too weighty, will cause a partial earthquake; at the same time the vapour will propel the melted matter to the part where it meets with the least resistance, and will there expel it, together with all the unmelted stony masses it meets with in its passage. It is easy to conceive, that before the dense melted matter is ejected, the dilated air of the volcano will be

be first forced out, and carry with it the ashes and looser stones adhering to the sides and coat of the volcano.* The substances ejected in this manner, are phlogisticated, fixed, and inflammable air, water, ashes, pumicestones, stones that have undergone no fusion, and lava. Besides part of the ashes, which, being plentifully moistened with water, forms tufa, traas, or terras, and puzzolana. The composition of these substances long puzzled mankind. It now is, however, generally understood, that marl, schistus, hornstone, schoerl, with a further addition of iron from the pyritæ, are the true sources of the melted matter, or lava. "It yet has astonished me," says De Saussure, "so few researches have been made into the nature of those stones, which, in fusion, produce the different lavas." M. Desmarest supposes granite to be the most common matter. "But, from all the experiments which I have made," says De Saussure, "it seems to me undeniable, that granites cannot be reduced into an homogeneous mass, even by the most violent heat of our furnaces; a heat which, even by the confession of M. Desmarest himself, is infinitely superior to that of volcanos." Granites, indeed, have

* Kirwan.

have been melted, but not until they were reduced into a very fine powder. Entire pieces always resist the action of fire. Hornstones, therefore, or the tender kinds of the schisti, either crystallized or in mass, which nature has scattered in such great profusion through the primitive mountains, and through those which lie intermediate between the primitive and secondary, have furnished the greater part of the homogeneous lava: and these same substances have likewise formed the greater part of those lavas, which contain grains of quartz, felt-spar, and other heterogeneous matters.

The puzzolana, traas, and tufa, according to some naturalists, are of a different nature.* The first is of a grey, brown, yellowish, but usually of a reddish colour; loose, granular, or dusty, rough, porous, and spungy, resembling a clay hardened in the fire, and then reduced to a grosser powder. The second differs but little in its principles from puzzolana, but is much more compact, and harder, porous, and spungy. The last is volcanic ashes, concreted with various other species of stone, but in which argill predominates: it is harder than traas, but still porous and spungy. Tripoli is likewise a volcanic

* Kirwan.

canic product; and the rotten-stone of Derbyshire is, according to Ferber, nothing but a tripoli, mixed with calcareous earth.

"Whatever be the cause," observes M. Raspe, "of the fusion and fluidity of smelted lavas, whether it be a strong heating fermentation, as seems highly probable, or whether it be a subterraneous fire, as commonly is supposed, without sufficient proof, it is a fact wanting no evidence, that the lavas of Ætna and Vesuvius either break their way from under ground, through the lower sides of these mountains, or ascend like boiling water to the very brim of their craters, which they overflow at last, and thence run down into the lower vallies; or that they are vomited and thrown out of these craters in fluid burning masses. It is fact, likewise, that the lavas appearing in their eruptions, like fiery torrents, either overflow the land above the sea, and refrigerate there, or that no eruption ensuing, they *refrigerate again within the volcanos*; or finally, that sometimes, according to the situation of the ground which they overflow, they run down into the sea or other water. Nor can there be any doubt, that by similar causes, violent fermentations, fusions, nay, eruptions of smelted substances, may be produced

produced even at, and under the very bottom of the sea.

M. Desmarest, an eminent mineralogist of France, in 1768, ventured to pronounce, that prismatical basaltæ are belonging to, and are produced by currents of volcanic lava. M. Ferber, in 1776, declared, that from every examination of volcanic productions he had been engaged in, he had been led to the same conclusion, and therefore was of opinion, that basaltæ should be considered as crystallized lavas; and M. Raspe, in the same year, gave it as his opinion, as above, that the prismatical basaltæ should be looked upon as currents of lava, cooled in sea water, or cooled of themselves under ground. But, the fact is, there is an unthought of variety of lavas and of volcanic productions, different in form, mixture, contents, solidity, nature, use, and situation. On the surface of the earth but few volcanos have been examined, although in the single province of Languedoc, more extinct volcanos are now known, than twenty years ago were known to exist throughout all Europe; and it is obvious, that different pre-existing rocks, and mixtures, under various circumstances and degrees of fusion, conflagration, and cooling, must have produced

produced as many different masses. Common loam, mixed with a little iron and sand, produces, by an intense heat of fire, a species of stone or vitrification, which has a strong resemblance to common lava. May it not be supposed, therefore, that the great chymical fire of nature should be found to have produced many species of rocks, which have never been thought of as of volcanic origin? Common glass, left to cool in a furnace, will very nearly assume the prismatical shape of basaltes.

Basaltæ, we may thus presume, to be unequivocal productions of volcanos, and that they are more common than is imagined. But, to explain in what manner they have been crystallized, or otherwise formed of the melted matter flowing from a volcano, has been the difficult and the important question. From Pliny, we learn that the Egyptians found a stone in Ethiopia *Lapis Ethiopicus*, which they call basaltes, from its having the hardness and colour of iron. Some modern mineralogists even insist upon basaltæ being real beds of stone, and to be similar in formation to freestone, limestone, &c. But, why is it asked, have not all stones the same determinate prismatical form?* Even the

* Raspe.

the very prismatical columnar lavas, or basaltæ, show varieties of form. Is it owing to the difference of their substance and mixture? To the different sloping of the ground on which their fiery melted masses run forward? To the different quickness of their motion? To their different fluidity? Or is it not rather owing to the manner of their refrigeration?

To these questions variety of answers have been given. "When the lava arrives at the margin of the sea," says Buffon, "the water, by its immensity, by the resistance of its cold, and by its power of arresting and extinguishing fire, soon consolidates the torrent of burning matter, which can now proceed no farther, but rises up, accumulates new strata, and forms a perpendicular wall." But, basaltæ are found in every situation; near and distant from the ocean, in solid strata and bare ridges, as well as in their ruins. All the roads and cities of many countries, such as Italy, in particular, have scarcely any other pavement. Moreover, as I have already said, they are found in great variety of forms. Many even affect the spherical, as those found in the Venetian State. But the most singular of all, are the kernels and nuclei of old volcanos, deprived, by rain, snow, overflowing water, and a long series of de-

stroying centuries, of their external covering, which are to be observed, particularly in lower Hesse. *

"Some masses of the basaltes of the island of Ponza," says Sir William Hamilton, "are in a perpendicular, others in an horizontal, and others again in an inclined position; and the rocks themselves, in which these masses are found, are lava of the same nature as the basaltes. One rock is composed of large spherical basaltes; and in many parts of the island, I found the lava had inclined to take the like spherical form, though on a much smaller scale; some of the first mentioned round basaltes being near two feet in diameter. In regard to the regularly formed basaltes, I have remarked, both at Sicily and Naples, that such lavas as have run into the sea, have been either formed into regular basaltes, or have had a great tendency to such a form. The lavas of Mount Ætna, which ran into the sea near Iacci, are perfect basaltes; and a lava that ran into the sea from Mount Vesuvius, near Torre del Greco, in 1631, has an evident tendency to the basaltic form."

Basaltæ, (sometimes erroneously imagined schoerl) in many instances, seem to owe their origin,

* Raspe.

origin both to fire and to water: they seem to have been at first undoubtedly a lava; but a lava, which, in a liquid state, being immersed in water, was so diffused or dissolved in it, with the assistance of heat, as to crystallize when cold, or coalesce into regular forms. * That basaltæ are, however, not the result of mere fusion, it is said, appears evidently by the comparison of their form with their texture. Their form, it being crystallized, should be the effect of a thin fusion; but, in that case, its texture would be glassy; whereas it is merely earthy and devoid of cavities. Hence we are to understand, how it comes to pass, that lava, perfectly vitrified, and even water, are sometimes found inclosed in basaltes.

The level of the sea, in former ages, in the valley of Cassel, is accurately to be traced. It ascended to a considerable height on the sides of the neighbouring hills. † The remarkable stratum which ascertains this level, consists of a friable, and more or less indurated ferruginous marl, or mud, and contains an innumerable quantity of calcined shells, and other marine substances, such as are common to the northern seas. Now the lavas, according to their qua-

* Kirwan. † Raspe.

lity, and to their situation in this country, as well as, perhaps, in many others, seem to have forced their way in a hot fluid state from under ground, and directly or latterly to have run into the sea; or to have cooled under its level, within the strata, caverns, and holes, wherein they had been brought into fusion. All the ancient Hessian basaltæ to be traced, have visibly been under the level of this ancient sea. The same, indeed, and in regard even to the present level of the sea, may be observed in Iceland, and between Scotland and Ireland. The columnar basaltæ are in those places to be observed *in the sea*, as well as on the shore.

Notwithstanding all this, it has been supposed by Sir William Hamilton, and by M. Ferber, that lava, and the most part of the prismatic basaltæ, do not differ in themselves, but only in their forms.* Nature, however, may assuredly be allowed to work similar effects, by dissimilar causes. The latter writer, indeed, acknowledges it himself; for he confesses there are some scarce species of basaltes, which seem to have been produced even by water; and that there are in Bohemia, and in different other places, slate and granite columns, which evidently owe their crystallization

* Raspe.

tallization to water. But, the truth is, as I have remarked above, that most lavas differ, as to their colour, solidity, weight, texture, and appearance. In regard to their forms, those must depend on the parts of which they are compounded, and the manner and time of their refrigeration. In craters and holes in volcanos, they undoubtedly cool slowest; for there their mass is less troubled by motion, and their heat is less influenced by the air and water. On the contrary, those which run into seas, or other waters, are more speedily indurated and given their specific shapes.

Of the various basaltine masses, however, which have been discovered, many, as I have said above, have been found irregular, although in general they affect an horizontal, perpendicular, or inclined direction. They are found in triangular prisms, in squares, pentagons, hexagons, septagons, octagons, and, even according to some authors, of nine sides. They are found round, articulated, and shapeless. They are found to differ in their colour, as much, or more, than in their principles. But of this the exterior coat frequently misleads. To be certain of a basaltes, it is often necessary to break it, and in its heart, as it were, to read

its pretensions. The columnar basaltæ are frequently observed of a prodigious height. At others, instead of a Giant's Causeway, there is merely discerned a *Fairy's Causeway*; as for instance, behind the castle of *Rochemaure*, in the southern parts of France, where a perfectly formed prismatic causeway of positive basaltæ has been found, not two feet in length, and not half a foot broad. But it would be endless to enumerate the instances of difference in basaltine substances: they are of all figures, and in all situations; they are found under the waters, under the earth, upon the earth, and even greatly above the surface of the earth. On the summit of *Mont Mézin*, in the Vivarais, which is five thousand feet above the level of the sea, there at this moment exists an enormous mass of basaltes. *

It has been remarked by M. Desmarest, that there are ten different parts of Europe in which the prismatic basaltæ are found, and which present marks of subterraneous fire. Two in Germany, one (he might have said two) in the Britannic Isles, four in France, two in Italy, without reckoning the neighbourhood of Vesuvius, and, finally, one in Sicily. To these we may add two

* Faujas de nt Fond.

two groupes of basaltine columns, discovered by Sir John Strange, in the Venetian State. But, of prismatic basaltæ, the most celebrated, undoubtedly, are those belonging to ourselves. The whole island of Staffa, one of the Western Islands, consists entirely of basaltic pillars, as regular as can be imagined, and which surpass those even of the Giant's Causeway in Ireland.* In most places the pillars are perpendicular, in others they are a little inclined, and yet in others they have the configuration of the timber-work, in the inside of a ship. The highest pillar is fifty-five feet, and each joint from one to two feet. They stand upon a firm basis, a solid, shapeless rock.

But, among the numerous vestiges of ancient volcanos, there are certainly few more stupendous, than those on the northern coast of Ireland, though no visible crater is now remaining, between Port Rush-strand and Ballery-castle, eastward, a distance nearly equal to twenty English miles; and yet, the whole of that space is one continued mass of lava: and the same appearances extend many miles from Port Rush, towards the west.† Port Rush-strand exhibits an awful wreck of the terraqueous globe,

* Sir Joseph Banks. † Whitehurst.

consisting altogether of immense masses of black lava, so extremely replete with bladder-holes, and so void of extraneous matter, that it perfectly resembles the scoria of iron, and therefore leaves not the least doubt of its being a volcanic production. This stupendous cliff is situated on the verge of the Atlantic, eight miles north of Colerain, and six miles west of the Giant's Causeway. The Giant's Causeway is a continuation, indeed, of the lava, the elevation of which is not apparently less than five or six hundred feet above the Atlantic: not one mass, or the effect of one eruption, but of many successive convulsions. The columns are in a vertical position, and of various diameters, from fifteen to twenty inches, and some thirty feet long. They seem all to be prismatical, or equally thick from end to end, though they consist of various regular figures, viz. pentagonal, hexagonal, heptagonal, and probably many other forms. Each column is apparently divided into equal parts, by means of transverse joints; but many bisect the columns partially, leaving five or six inches of the central part solid. In some instances, the joints extend quite through the columns, but they have originally, perhaps, united, and probably separated by water lodging and freezing in them. The articulations are

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not flat, but convex and concave, exactly fitted together, but not in any order with respect to the convexity or the concavity being upwards or downwards; for in many instances they have been observed in both directions. The columns are of one colour, and of one density, and free from bladder-holes. "As these basaltic columns," says Whitehurst," have assumed a variety of prismatic appearances, the presumption is great, that their various forms are not owing to any property of crystallization, since it is universally allowed, that similar substances, under similar circumstances, invariably assume similar figures. The cause, indeed, is hard to be ascertained. I myself am of opinion, continues Whitehurst, (supposing, as I do, that these basaltic columns were originally in the very heart of the mountain, in a state of fusion, protected by scoria from the external cold) that they received their form from contraction in cooling, from an immense degree of heat, to their present temperature. And that which corroborates the opinion is, that toadstone, channel, cat-dirt, and black clay, found in Derbyshire, are all lava, and flowed from volcanos, whose funnels did not approach the open air, but disgorged their fiery contents between the strata of limestone, in all directions. In the fissures also of *limestone* they are found.

A further proof, if necessary, that the lime-stone must have been first formed, and subsequently broken, ere it were possible for these fissures to be filled up."

In opposition, however, to this opinion, that the basaltic columns do not owe their various forms to any property of crystallization, we have the sentiments of a late ingenious writer,* who has evidently studied his subject with ability and precision. "A crude and indefinite hypothesis," says this gentleman, "has been adopted, that the pillars of basaltes, at the Giant's Causeway, were produced by the refrigeration of a liquid body of lava, in consequence of being suddenly plunged into water. Such is the theory of M. Raspe; and such are the sentiments of M. de Luc, who imagines that the ancient volcanos were formed in the ocean, when the sudden cooling of the melted mass (not to count on the presence of the marine salt) might have determined a regularity of figure in the cooling body. But, this ought not hastily to be adopted, for the furious encounter of a river of liquid fire with the waters of the ocean, so far from being suited to form the neat and elegant arrangement of these pillars of basaltes, could only tend to introduce

* Mr. Hamilton.

introduce confusion and irregularity. But, in truth, any argument derived from the particular situation of the Giant's Causeway will be found extremely erroneous, because the circumstances of its standing in the sea is purely accidental; similar pillars being often discoverable on the summit of the *highest grounds* in the neighbourhood, many hundred feet above the level of the beach. Nay, the Causeway appears to have extended thro' a large tract of country in every direction, insomuch, that many of the common quarries, for several miles around, seem to be only abortive attempts towards the production of a Giant's Causeway. Through a space of more than forty miles in length, and twenty miles in breadth, that is, through above eight hundred square miles, the great cause which generated this species of stone, exerted itself. In kind, this stone seems as perfect as any hitherto discovered. Its component parts are iron in a metallic state, combined chiefly with siliceous and argillaceous earths. Its power of magnetic attraction is proof of this; each fragment of a pillar having its attractive and repellent points. Bergman's experiments shew, that one hundred parts contain, of

Siliceous

Siliceous earth,	50
Argillaceous earth,	15
Calcareous earth,	8
Magnesia, - - -	2
Iron, - - - - - -	25
	100

Thus, from a knowledge of these elementary parts of basaltæ, we are furnished with an analogy tending to throw some light on the regularity of their form. One of their principles is found to be siliceous earth, and we have numerous proofs, that this substance does, in other instances which come within our observation, frequently affect a regular figure; variable, however, under various circumstances. Thus, rock crystal, which is a very pure flinty earth, is commonly disposed in the form of hexagonal prisms, the denomination of sides, which chiefly prevails among our basaltine pillars. These varieties of crystallizations are found to take place in the metal of glass-houses, where the furnace has been suffered to cool gradually. And though crystals have probably never been produced from any simple substance, precisely answering to the articulated basaltic pillars, yet no very important objection can thence be derived, since it is well known,

known, that elements which separately form specific crystals, may, when united, constitute, by their compound laws, bodies different from either figure. Thus, melted glass, through which scoriæ of iron has been accidentally mixed, has been found to affect a columnar shape. *

The Giant's Causeway is black, close, and uniform. Its variations of colour are blue, reddish, and grey. Its grain is all that can be supposed from extreme fineness, to the coarse granulated appearance of a stone, which resembles imperfect granite, abounding in crystals of schoerl, chiefly black, though sometimes of various colours. † These basaltæ, or rather their varieties, are justly esteemed to be owing to accidental circumstances attending their course, or the manner of their cooling. "For, as they are formed from a limous lava," says De Launy, which consists of argillaceous and siliceous earths mixed with iron, and are decomposed by long *maceration in water*, so their mass, being gradually dried, is, by the retraction of the argillaceous earth, split into regular prismatic fragments." And this may be observed in the kind of clay, called, by Wallerius, argilla vitrescens tessularis, which, as it dries, breaks into cubes. But

* Phil. Trans. † Mr. Hamilton.

But, how will this account for the spherical basaltæ, which at Pradelle, in the higher Vivarais, are found in such extraordinary quantities?

"Some speculative men," says Mr. Hamilton, "attribute the formation of basaltes to the refrigeration of a current of lava, suddenly plunged into the ocean; others obscurely hint, that some occult quality in the sea may have its share in the business." Mr. Kirwan, contrary to experience, supposes that the melted mass of lava might, in its liquid state, have been capable of a considerable diffusion, or solution in water, by which means the particles may have had an opportunity of arranging themselves in regular crystallizations. Bergman conceives that basaltæ were originally a bed of iron and other substances, gradually moistened, and softened in the streams of water, heated by subterraneous fire, and afterwards assuming a regular figure, during the time of drying and hardening. But, in truth, does there appear any but one operation of nature, which affords any rational principle of analogy, by which we can attempt to explain the formation of basaltic pillars? it is certain that the particles of most bodies, when removed from each other to a proper distance, and suffered to approach gradually, assume

sume a peculiar form of arrangement, as if the parts of each species of matter did, independent of their general properties of cohesion and gravity, possess also private laws and affinities, tending to produce their specific forms. Thus, whether bodies be dissolved by fire, or by a watery medium, the phænomenon of crystallization is equally observable, when proper art has been applied to render its effects visible. And hence it does not seem unlikely, that basaltic pillars may have been formed by a process exactly analogous to what is commonly denominated, *crystallization by fusion.*

"The only apparent difference between the basaltic crystals," continues Mr. Hamilton, "and those which are produced in our diminutive laboratories, seems to be in the complete disunion of the pillars, and in the articulated form, which they sometimes exhibit. But this will not appear to be a matter of any importance, when we reflect that in natural operations of the same kind, but differing in magnitude, the same proportions are commonly observed between the different parts. Thus, the same ratio which the diameter of a basaltic pillar bears to the diameter of one of our diminutive crystallizations, will the interval between the pillars of basaltes bear

bear to the interval between the parts of our crystals; and whoever will take the trouble to calculate this distance, will find it so very small, as easily to admit the different surfaces, within the limits of cohesion; so that no separability of our crystals into joints, can possibly take place from their smallness, though they often bear marks, which might lead one to imagine them capable of disunion.

It is objected, that the currents of lava which have issued from Ætna and Vesuvius within the memory of man, have never been known to have exhibited this regularity of arrangement. It is therefore said, that experience does abundantly prove the fallacy of the volcanic hypothesis of the origin of basaltes. In reply to this we say, as I have before noticed, that it is not in the erupted torrents of these volcanos we are to look for the phænomena of crystallization, but, in the interior parts of the mountains themselves, and under the surface of the earth, where the metallic particles of the lava have not been dephlogisticated by the access of fresh air, and where perfect rest, and the most gradual diminution of temperature, have permitted the parts of the melted mass to follow their proper laws of arrangement, so as to assume

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the form of columnar lava: so that we must wait until the volcanic mountains, which at present burn with so much fury, shall have completed the period of their existence; until the immense vaults, which now lie within their bowels, no longer able to bear the incumbent weight, shall fall in, and disclose to view the wonders of the subterranean world; and all those varieties of crystallizations, which must needs take place in these vast laboratories of nature. For nothing is probably more true than that they do abound in basaltic pillars of regular arrangement: at the same time, that it is not true, that neither Ætna nor Vesuvius give us any instances of basaltine prisms: they both of them do, and in an unequivocal manner.

Wallerius, and other eminent mineralogists, deny that basaltæ have air holes like lava, and consequently, that they do not possess those marks of *vitrification*, which attend even a very moderate heat in our laboratories. But, almost all basaltæ do possess air holes, and hence their objection is a proof of the volcanic origin of the basaltæ.* With regard to the want of all marks of vitrification, we are to consider that substances in fusion are very differently affected, in proportion as they are more or less exposed

* Mr. Hamilton.

to the access of fresh air, the presence of this element being absolutely necessary, in order to deprive a body of its phlogiston. Thus metals, which may be readily vitrified by exposure to heat and the free afflux of air, will yet bear the most intense action of fire in close vessels, without being deprived of that principle on which their metalliety depends, and are therefore in this situation *incapable of being vitrified.* The basaltæ may, therefore, have been subjected to a very great degree of heat within the bowels of the earth, and yet shew no marks whatever of vitrification, and hence we are enabled to assign the reason why the iron principle of the basaltes still retains its phlogiston, and acts so sensibly on the magnetic needle. But, besides this, it is contended, that the heat of volcanos is not intense. This will surprize you. And yet it has great probability on its side, from the circumstance of *schoerl* and *garnets*, which are fusible by themselves in our furnaces, being frequently discharged from volcanos, in their perfect crystalline form. Nay, so common is the presence of these substances in lava and other volcanic bodies, that able naturalists have been led to suppose them the productions of subterraneous fire. * The little white garnets

* Ferber.

garnets of twenty-four sides, friable and opaque, which are found in such abundance in the volcanic matter that covers *Pompeïa*, though they have been altered by the acid vapours, which have dissolved the iron that coloured them, and left them, from the empty spaces occasioned by the absence of the iron, in a state of whiteness and porosity, are nevertheless regular and perfect in their crystalline shape. *

Mons. Faujas de St. Fond observes, that at the foot of the mountain of Mezinc in the province of Velay, a range of basaltic pillars stands supported on a bed of fossil coal, with a very thin stratum of clay interposed. Now, that this inflammable body of coal should have remained uninflamed, under a mass of melted lava, thirty feet thick, seems highly improbable, and therefore it is evident, say the adversaries of the volcanic system of basaltes, that the basaltæ could not have derived their origin from fire. But in answer to this plain objection, it is affirmed as plainly, and I think much more satisfactorily, that no substance in nature can be consumed by fire without the accessof atmospheric air; that fire may be passed through inflammable air itself, without exciting actual inflammation,

* Sage.

unless the atmosphere lends its assistance. And that thence coal might have survived in the neighbourhood of volcanos, and even under a mass of fluid lava, which by resting on it, would prevent every possible approach of fresh air, so absolutely necessary to its being inflamed.

Thus we have gone through the opinions of the most enlightened writers on the subject of lavas, and of volcanic basaltæ. A summary, however, of the most probable system may not be amiss as a conclusion, especially as we have it from the hands of the learned M. Veltheim, who has for several years past been at the head of the department for superintending and conducting the mines and works of Hanover and Brunswick. His opinion, indeed, coincides very nearly with what we have already recited, and which I have no difficulty in saying, I believe to be that most to be depended on. He supposes a quantity of pyrites, very rich in iron, to be fused with certain contiguous earths into a thin mass, by the fire of a volcano; and that if an eruption takes place, this lava, which is brought into contact with the air, will cool too suddenly to admit of any regular form; but that such part of it as remains within and quiet in the bowels of the mountain, will cool slowly, and be left

left without interruption to form crystals, or rather, by the gradual diminution of bulk, to split into regular pillars; until in the course of time they shall be exposed, from the dilapidations of the mountain. The chief arguments of Mr. Veltheim, are founded on, 1st. That Sir William Hamilton has mentioned basaltæ which have been thrown up during an eruption of Vesuvius. 2d. That Faliasi has given a view of an extinguished volcano with pillars in the crater. 3d. That Mr. Kier's crystals of glass, as described in the Philosophical Transactions, have a most positive analogy to basaltæ. 4th. That a black scoriæ, resembling basaltæ both in structure and composition, may be made by fusing clay and siliceous earth; or granite with pyrites not decompounded. And 5th. That the garnets found about volcanic mountains are, from fusion, to be imitated by art.

And here we close. It will, however, be necessary you be upon your guard against mistakes with regard to a substance, which has every appearance of being a basaltes; but which is in fact of aquatic formation. This is what the Swedes call *trapp*, or trapas, from stairs. This substance is, at times, found in prisms. It is the toadstone of Derbyshire. The mountain

Esterelle, on the shores of the Mediterranean, in the southern parts of France, although a huge colossus, as you may remember, of an inferior kind of porphyry, exhibits trapp in great abundance, and in the shape of a parallelogram, and rhomb, as well as in that of a prism. Green trapp is of a blackish green, compact, heavy, and hard of texture, giving fire with steel. It is the *trapezum virescens*,* and was often used by the ancients in sculpture, as in the Morpheus in the Tribune at Florence; and is what is generally called Egyptian or antique basaltes. Black trapp, or what is called touchstone, was likewise used in the same manner. †

* Born. † Faujas de St. Fond.

LETTER XLI.

THE veil which has thus been rent from one of the secrets of nature, shews to us in vivid, but in awful colours, the subterranean vicissitudes of the globe. Nor are the benefits resulting from such discoveries inconsiderable. Whatever turns the mind intensely upon unvisionary contemplation, tends to concentrate its powers, and to fit it for bolder and more exalted flights: The developement of physical causes, opens and enlarges the boundaries of human reason. Until the present century—or rather, indeed, late in the last—the internal structure of this earth had not been examined with attention. And yet it is there where the chronicles of the world are to be found; where we are to seek for a knowledge of the revolutions of ages; where we are to read, in letters legibly written, the changes, however disastrous, of nature; and where alone the proofs of the antiquity and the pre-existence of nations are to be traced. At what profound depths are the soils of ancient

worlds! our confined imaginations, accustomed to the immediate and general state of earthly repose, are scarcely able to fathom them. Yet man is, or has been every where: the whole globe has been his cradle. No one part of the mass has been less indigenous to him than another. The bottom of the sea he can claim as his, as well as the continental land. The strata beneath the very lowest that have yet been explored, were once as appropriate to his use, as the surface or outermost rind on which he treads at present.

In the dreary regions which cover and hide from observation, the tremendous laboratories and furnaces of nature, the alternate strata of lava and soil have been considered as sufficient data for proving the antiquity of the world; taking for granted, that the quantity of soil contained in each stratum has been produced by length of time only; not considering that eruptions of sand, ashes, or mud, are equally frequent with those of liquid fire, and that such productions become immediately fit for vegetation. It appears much more probable that volcanic soil strata proceeded from subsequent eruptions, than from length of time.* And, indeed, this idea is to be supported from the relatively small surface

* Whitehurst.

surface which ejected lavas present to the atmosphere. These require many years to cool; and many hundreds of years to effect their total decomposition. At the same time, that their decomposition will be quicker or slower, in proportion as they have been more or less perfectly melted. Sir William Hamilton says, "the dense lava of Vesuvius forms one or two feet of mould in a thousand years."

The globe, we thus perceive, at least to a certain depth, is not every where solid; but is intermixed with mighty caverns, whose arches support the incumbent earth, which in the progress of time inevitably give way. Then instantly rush in the waters, and by filling them, leave a quantity of dry land, which shortly becomes an habitation for terrestrial animals. These, in their turn, undergo a similar fate. Thus succeeds revolution to revolution. When the masses of shells were heaped upon the Alps, then in the bosom of the ocean, there must have been portions of the earth, unquestionably, dry and inhabited: vegetable and animal remains prove it: no stratum hitherto discovered, with other strata upon it, but has been, at one time or other, the surface. The sea announces every where, its different sojournments:

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and at least yields conviction, that all strata were not formed at the same period. At what a profound depth are beds of coal, the formation of which must have been posterior to the formation of the vegetables, of which they are composed, and which vegetables must have flourished on the surface of the earth, or on the bottom of the sea. In the country about Namur there are coal pits at the depth of two thousand feet. At Whitehaven, a vein of coal runs even a quarter of a mile under the sea. But, all strata of limestone, chalks, marbles; all gypsums, spars, alabasters, &c. are confessedly of animal origin: those of coal, and of all bituminous fossils, and the mould every where covering the surface of the earth and other substances, are supposed, as we have already seen, to have arisen entirely from the destruction of animals and vegetables.

Fire, and water, have in this manner left the most indubitable marks of their respective and conjoint ravages on the earth. The former, however, has, to external appearance, worked only in some parts of the surface; while the latter, in its crystallizations, has scattered its offspring of granite almost universally. Yet, if the volcanic theory of basaltes be well founded,

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and no doubt the arguments in favour of it are convincing, at least to me they are irrefragable, a scene of horror is presented to our view, which must fill us with astonishment; since on this system it will be found, that there is hardly a country on the face of our globe, which has not at some time or other been wasted by the fury of subterranean fire.* For instance, independent of those we have already mentioned, what innumerable volcanic remains in Asia, in the Philippine, in the Molucca, in the Japan, in the Bourbon, and in the Sumatra islands. In Africa, how prominently they appear. Teneriffe, which, according to Heberden, is 15396 feet above the level of the sea, or nearly three miles. Madeira, St. Helena, the Azores, Johanna, and the Comoro islands, &c. besides what may be yet undiscovered in the interior parts of the continent. In America, particularly the Southern America, what a volcanic chain! the grandest that exists in nature, with Cotopaxi for its principal link. How interesting would a volcanic map of the two hemispheres be! What a world it would shew us! If again those apparent vestiges of marine productions, which are observed indiscriminately scattered through the earth at all depths below its surface, and on the summit

* Mr. Hamilton.

summit of its highest mountains, be esteemed sufficient proofs of the presence of the ocean in those places, a scene no less wild and uncommon than the former, rises before our imagination; in which the products of the Equator and the poles appear to be jumbled together, in a manner incapable of being explained by any of the known analogies of nature.

The immense quantities of petrified sea bodies, found in so many different places and situations, are assuredly instances sufficient to prove, that they could not have been transported and deposited in those situations by the waters of any one general submersion; for the greatest part of them, instead of being found in the bowels of the earth, and in solid marble at the depth of seven or eight hundred feet, must have remained on the surface. * Another proof is, that the bones, horns, claws, &c. of land animals, are seldom found in a petrified state, and are rarely incorporated in marl or other hard stones; whereas, if these effects had been produced by a deluge, the remains of land animals would have been found in marls, as well as those of fishes. Let us look into the excavations that have been formed by nature or by art.

From

* Buffon.

From the lowest valley whence we can descend, we find prodigious heaps of marine bodies at immense depths, either in quarries of calcareous stone, in fossils, &c. and we find them also in the towering strata of mountains; in the mid regions of continents as well as in islands; from the summits even of the Alps, to some hundreds of feet below the level of Amsterdam.

The strata in which many fossils are thus found, prove them, I must believe, to be of an antediluvian period,—a period beyond the records of men, and attended with such circumstances, that we might not unreasonably conceive some calamitous event had destroyed the greatest part of animal life from the face of the earth, and consigned to oblivion a cause, the record of which must otherwise have been transmitted from posterity to posterity, to the very end of time. * These fossil phænomena, indeed, afford a sufficiency of examples to incline philosophers to the opinion, that the earth has undergone commotions abstracted from a deluge, and that those commotions might have destroyed its inhabitants partially, if not generally. But, had the sea little by little got over the face of the earth; had it covered and proportionably

* Antiquity of the Earth.

portionably uncovered the plains and the loftiest mountains; we should in such case, with the spoils of that element, every where find innumerable vestiges of the habitations of men. We should every where see monuments varied according to countries, and shewing as many different characters, as there have been revolutions in the immense duration of eternity. But, there are no such traces to be discovered. In every corner we see marks of the dwelling of the sea, but none of those submerged monuments, which ought to be met with. The earth, then, must repeatedly have burst, and the waters have rushed into the chasms, and closed the scene of existence.

The petrifications which are thus found in a fossil state are various. It is worth, however, observing that those of shells, are found on, or nearest to the earth; those of fish, deeper; and those of wood deepest. * That organic substances are most commonly found in strata of marl, chalk, limestone, or clay; seldom in sandstone; still more rarely in gypsum; but, never in gneiss, granite, basaltes, or schoerl; but that they somesimes occur in pyrites, and ores of iron, copper, and silver; and that they are found where

* Kirwan.

where their originals could not have existed. The calcareous petrifactions consist of calcareous stones, in the form of animal or vegetable substances; the former are called zoophytes; the latter phytholites. The most remarkable of the former are, first, those of the coral class, of a ramified and tubular form, as coral, madrepores, millepores, astroites. Secondly, those of the class of sea worms, as belemnites, which are of a conic or cylendrical form; asteriæ and entrochi, which have a starry appearance. And thirdly, those of the testaceous class, as nautilites, ammonites, echini, &c.

Stony, mineral, and stalactitical concretions may be found in caverns, where, by affinity, and the different laws of attraction observable in heterogeneous bodies, the air may dispel the fluid vehicle, and thus complete the consolidation. Agglutination may also be produced from the sperm of shell fish, and sea animalculæ, which, operating on certain heterogeneous bodies, will unite them into a firm mass. By this process, certain soft land, which is often undermined by the sea, will, as we have before observed, become rock. But, says Mr. Douglas, * the induration of bones and skeletons, &c. cannot be per-

* Antiquity of the Earth.

performed in so small a period of time. These remains were certainly of the antediluvian world. Stalactical matter, and some minerals, may be produced under human observation; but, has the operation of indurated chalk, flint, &c. ever been noticed in its progress, or its induration satisfactorily accounted for?

There was much ground, indeed, at one time, for this question: for, though the Scripture declares, that all the foundations of the great deep were broken up, yet we have no authority to conclude, that this convulsion was in its effects equal to those which have produced the fossil phænomena, that are found in the bowels of the earth, in all quarters of the globe. This, doubtless, would have procured effects similar to those which are found to attend circumstances descriptive of similar connections; such as the strata of fossil bones, found on the coasts of Istria and Dalmatia, in the islands of Cherso and Osero, in the island of Cyprus, in most of the islands of the Ægeian sea, and the rock of Gibraltar; which imply the most convincing proof of an alluvian, by the dislocation and fracture of the bones, and here and there small specimens of shell fish embossed in the mass; whereas, all the large spoils of marine animals

are

are never found with them. Moreover, the produce of respective climes so imbedded, ought to have been found approximate to the spot, where the convulsion so happened. But, whence the exotic fossils that have been discovered?

In North and South America, in Russia and Germany, fossil tusks and bones, of a very large size, have frequently been found. According to tradition, these were reported to be the tusks and bones of the mammouth, an animal, which, if it ever existed, is no longer known as an inhabitant of any part of our globe. Mr. Pennant, indeed, thinks that it still exists in some of those remote parts of the vast new continent, not yet penetrated by Europeans. Several eminent naturalists of late years, as Sir Hans Sloane, Gmelin, Daubenton, and Buffon, are of opinion that these prodigious bones and tusks are really the bones and tusks of elephants; and many modern philosophers have held the mammouth to be as fabulous, as the centaur. But the two celebrated Doctors Hunter have proved, by the dissimilitude of these fossils with the bones and tusks of the elephant, but more particularly from the shape of the grinders, which clearly appear to be those of a

carniverous animal, or at least of an animal of the mixed kind, being furnished with a double row of high and conic processes, as if intended to masticate, not to grind the food; and the enamel making a crust on the outside only of the teeth, as in a human grinder, that they are totally different from the elephant: the elephant being well known not to be carniverous, but to be of the graminivorous kind, both from the form of its grinders, and by its never tasting animal food. Others again have supposed these fossil bones to belong to the hippopotamus; but, there are many reasons against such a supposition. The hippopotamus is even much smaller than the elephant, and has such remarkable short legs, that his belly descends within three or four inches of the ground. The fossil thigh bones of the mammouth, on the contrary, are evidently the thigh bones of some amazingly large animal. There are some of them nearly four feet in length: and they consequently are, with pretty strong arguments, proved by Dr. Hunter not to belong to the elephant, or the hippopotamus.

These fossil remains, then, would lead one to conjecture, that the animals they belonged to were of a race, which, from some casualty, is now extinct. The wisdom of God may have made

other

other kinds of things before this present face of being began, and may make other kinds of things after that this face of being shall be no more. But the unknown existence of the animal is all that we can argue from. The principal property of nature, is to be always consistent with herself. Gravelly and sandy soils, which often abound with the vitriolic acid, will in a short space of time, consume or decompose animal substances; whereas chalky and marly soil, not having the acid quality in any like proportion, will preserve bones, when secure from the filtration of water, to any length of time. Yet, a petrified human body was found in 1722, which lay buried above fifty years in the copper mines at Falham in Dalecarlia, according to Linnæus. Now this is a recent fact, which furnishes an undeniable proof that petrifications have been produced within these last hundred years; and hence no very conclusive argument can be deduced from the petrification of animal substances, in favour of antediluvian phænomena. The more convincing criteria are those we have already touched upon. The evidence is clear, that the sea and land change place, not only from the effects of general and stated periodic laws, but from a variety of revolutions occasioned by particular and accidental causes. Thus the surface of the earth,

which we look upon as the most permanent of all things, is subjected, like the rest of nature, to perpetual vicissitudes.

These disasters, so indelible in their marks, are the result of the pre-established laws of nature, and shew how irrevocably it is fixed, that some parts shall be deranged for the prosperity of the whole. It is thus, that comets have presented themselves to the surprized sights of philosophers; that their eccentric course has been dreaded as eventually tending to trouble the tranquility of our solar system; that terrors have been excited by them, even in the breasts of the enlightened; and that naturalists have fancied, all the destructive revolutions of the earth to have had their origin in their energy and influence. But, the Great Ruler of the universe has so ordained it, that sometimes the seasons shall be displaced, sometimes the elements shall be in discord, the sea shall pass its limits, the solid earth shall shake, mountains shall run and embrace each other, contagion shall destroy man and beast, and sterility shall desolate countries. But, these afflicting disorders are effects of causes purely natural, acting conformably to fixed laws, and determined by the established nature of things.

Nor let us conclude that destruction alone is to be observed on the surface of this earth. Many, as we have seen, have maintained the universal volcanic generation of mountains. Certain islands indisputably have been thrown up. And though we may differ from them in a general sense, we willingly concede to them particular instances. The volcanic generation of mountains is not to be doubted; any more, than the granite accumulations in the ocean, which at this moment perhaps are crystallizing into what shall, at some future period of the world, be Alps or Cordelliers. On the 12th of May, 1707, a new island sprung up near Saint Erini, in the Archipelago. "We observed at sun rising," says F. Bourgignon, "between the two burnt islands, a floating rock, as it were, which at first we took to be some vessel shipwrecked on that coast, and seemed as if it would be, in a little time, dashed to pieces. On which account some mariners put out immediately to sea in order to view it. Soon after, we were surprized to hear from them that it was a shoal beginning to spring up from the bottom of the sea. Next day, several persons went out of curiosity to satisfy themselves; some of whom went ashore on this new land, which was still moving, and sensibly in-

creased under their feet. It continued to increase in height and extension, very sensibly, from its first appearance to the 13th or 14th of June, and that without any noise or disturbance, although two days preceding its first appearance, there was an earthquake felt all over the island. On the 10th of July, at sun set, we perceived a chain of rocks, as it were, that rose up from a prodigious depth of the sea, to the number of seventeen or eighteen, not very distinct from each other, and apparently inclining to join themselves to the new island. The next day, smoke was observed to break forth, much resembling in thickness and colour that of a burning furnace; and at the same time were heard certain murmurings under ground, which seemed to proceed from the center of this new island. The rocks then recently formed, united together, and seemed to form another island distinct from the former. The smoke still increased; but, on the following day, the fire broke forth, at first of a dull colour, but afterwards more vivid, as the island increased, and so continued, and from a variety of apertures. It was no less frightful than curious to the sight, to see every evening on the top of this mount, that nature had lately formed a vast number of burning furnaces, as it were, all of a bright flame, and

and not unlike the illuminated minarets of the Turks, which, in that quarter of the world, are so frequently to be seen. One night, however, at the latter end of July, there appeared of a sudden, in the middle region of the sky, a fiery lance, seeming to come from east to west; but, it disappearing again as suddenly, its dimensions could not be exactly ascertained. In the mean time, the burnt island increased prodigiously, and extended itself chiefly on the south and north sides; the sea also seemed much more disturbed, and was loaded with sulphur and vitriol; the boiling of the sea was more fierce and violent, the smoke became thicker and in greater abundance, and the fire larger and more frightful. But, above all, a stench which infected the whole country, became so intolerable, that persons of the strongest constitutions could hardly breathe in it. In thirteen or fourteen days there was a considerable alteration in the size and appearance of these islands; they became considerably higher and longer, and at length absolutely joined and formed but one island. This phænomenon grew every day more curious, more dreadful, and less accessible, and was so far from ceasing to increase at the approach of winter, that it was seen continually to extend itself on the south west side, where nature seemed as if she laboured to make a large port

for ships; and on the 20th of November, it appeared to be at least three miles in circumference, and forty feet in height."

To these, many instances might be added, of the volcanic generation, as well as of the volcanic destruction of islands. Various publications are full of them. But, there was an eruption of fire in Iceland, and that very lately, not longer ago than the year 1783, which is particularly worth attending to:—In the month of June of this year, for some days, a continual smoke or steam arose out of the earth. Three fire-spouts broke out. After rising to a considerable height in the air, they were collected into one stream, which ascended so high as to be seen at the distance of thirty-four miles. The fire was mixed with prodigious quantities of brimstone, sand, pumicestone, and ashes. Along with the pumicestone there fell a great quantity of dirty substance like pitch, sometimes in the form of small balls, and sometimes like rings, or garlands. The fire was sometimes in a continued stream, and at other times in flashes, and was accompanied with a noise like thunder. The phænomenon continued the whole summer. In about eleven days the red hot lava began to run. An extent of fifteen miles long, and seven miles

miles broad, was covered by this lava. The perpendicular height of its edge was from sixteen to twenty fathoms; so that wherever it came, it covered every village it met with, as well as several hills. But, in the winter, the greatest wonder appeared: two islands were thrown up. One of these made its appearance in the month of February 1784, where the water was before upwards of an hundred fathoms deep. This island is above half a mile in circumference, full as high as the mountain Erian in Iceland; and by the last accounts, continued burning with great violence. The other island, which is at a greater distance northward, is yet larger in circumference, very high, and has likewise continued burning without intermission. *

Creation, and destruction, thus regularly succeed to one another. Nothing is at a stand. All is in motion, and every revolution serves but to some wise purpose. Thus, while some regions are undermining, others are forming; while this mountain crumbles, its resemblance consolidates in the ocean; while flints, jaspers, petro-silex, felt spar, granites, lavas, and ferruginous stones, from long exposure to the air, fall into a state

* Pennant.

state of decomposition, similar bodies and crystallizations assume their distinct shapes, and wait but to be called into being. This succession is most admirable. Every particle of matter thus comes into action. But the time required for such regeneration is infinitely, perhaps, too unbounded for the circumscribed imagination and faculties of man.

In labouring thus pertinaciously to represent to you what has been conceived on the subject of volcanos, I fear I may have fatigued you. But, in a complicated question, too much attention to particulars cannot be given. Volcanos have at all times been considered as features of importance in the face of nature. Homer forgot not to commemorate Ætna: Polybius, who lived one hundred and fifty years before Christ, takes notice of Vesuvius, in his description of Italy: and Diodorus Siculus, who flourished under the reign of Augustus, and who had employed thirty years indefatigable industry in composing his Historical Library, tells us, "that the eruptions of Vesuvius were lost in the darkness of remote antiquity." There is a remark however made by a great chymist, which we have not yet noticed, but which is striking. "Volcanos," says he, "are not found in the primitive

primitive or granite mountains, because in these mountains there are neither pyritæ nor bitumens; neither are they found in the metallic mountains, because these have not bitumen. The order of mountains, therefore, amongst which they are generally to be found, is, in my opinion, the third, in which there are not only inflammable substances, but quartz, calcareous, and argillaceous earths, and iron."*

All this may be true, at least, according to certain partial appearances But, though there are no volcanos among the *central* chain of the Alps, for instance, there are among their skirts towards Lombardy; and what is more, there are among the Cordelliers. "It is not, therefore," says De Saussure, "the mass of the mountains, nor their extension, nor the depth of their roots, which necessarily admit or preclude the existence of volcanos. The neighbourhood of the sea alone would seem necessary to the burning of those inflammable matters which are in the bowels of the earth. And thus, for example, near the Adriatic, the Alps afford considerable vestiges of volcanos; whereas, all the way from the neighbouring mountains of Verona, to the sea, between Genoa and Nice, there are

* Sage.

are no certain indications of the actions of volcanos: nor do the Apennines, in the neighbourhood of the Alps, afford any appearance of volcanic substances; though between Bologna and Florence they commence in the most evident manner, and continue, with little interruption, to Calabria."

"We are led however to conclude," continues De Saussure, "that the existence of volcanos is prejudicial and ruinous. But the subject is to be considered, in my mind, in another point of view. For instance, we know there is an uninterrupted consumption of air and of water, which abandoning their fluid form, change into solids, as into corals, shells, calcareous earths, stones, &c. which calcareous earths and stones intrinsically have more than half their weight of these two elements. This water and this air thus combined, cannot be liberated but from the *decomposition* of the bodies into which they have been converted. Now calcareous stones do not decompose of themselves: the impression of the air may separate their parts; water may carry those parts off, or combine them with other bodies, and by that means occasion them to take a thousand different shapes; but, still they are unable to decompose them. Acids, indeed,

indeed, may set free the fixed air that is contained in calcareous earths, but they cannot separate the water which is united with them. Fire alone is capable of this decomposition, and of liberating at the same moment both water and air; nor this a fire less violent than is necessary to *vitrification*; for were it only equal to what is necessary to *lime*, the lime would by degrees regain from the atmosphere those elements of which it had been robbed. Now, may not this decomposition, this prevention of every thing running into solids, be one of the great uses of subterraneous fires? May not these fires be destined to break the too strong union which marine bodies would otherwise establish between the earth and the elements of water and of air, and, by this means, give back to nature those two fluids, without which our globe would speedily become a desert? May it not be for this great end, also, that volcanos have been so multiplied, and so successively spread over the whole surface of the earth?"

Generations, likewise, as we have already seen, are often consequent upon volcanos, as well as destructions. Sir William Hamilton contends, "there are more mountains formed by explosions, than there are countries torn to pieces by subterraneous

subterraneous fires. The *Campagna Felix*, *Misenum*, *Baia*, *Puzzuoli*, *Pausilipo*, even *Naples* itself, have been produced," says he, "by such seeming destruction." *Ætna*, with its half hundred cones, I have before mentioned. Even the imperial city of *Rome* is built upon a soil which abounds with signs of volcanic explosions. The Campagna of Rome is scattered over with fragments of lava, and wherever the earth is open, one discovers the strata of volcanic cinders and tender tufa.

The catacombs of Rome are hollowed in a sort of puzzolana earth, of a brown violet colour, mixed with crystals of schoerl, of the form of garnets, the same as those in the partridge-eyed lava of Naples. Yet, in these have been found the *bones of whales*, and other foreign bodies, which seem to have been deposited there by the sea. Hills of sand, pebbles, and shells, were distinctly formed on these plains of puzzolana, and amongst them other vulcanos burst out, whose cinders covered these hills, that were formed by the sea. * Lava is not, however, at all necessary to prove the existence of volcanic eruptions. This volcanic substance is rare, in comparison with many other mixtures and combinations of different

* De Saussure.

rent matters, which have no appearance of vitrification. Mons. de la Condamine says, he could never discover any substance like lava in America, though he was encamped months on the volcanos of Peru, particularly on Pitchienchæ, Cotopaxi, and Chimboraço, on which he only saw the marks of calcination without liquefaction.

Volcanic mountains, indeed, and volcanic countries, such as those of the Southern Italy, clearly owe their origin to eruptions; and to eruptions bursting from a *plain*, on which the cones were subsequently reared. The fires which worked in the *Campi Phlægrei*, Sir William Hamilton supposes to have been under the bottom of the sea, as moles here and there throwing up a hillock; and that the matter thrown out of some of these hillocks, formed into settled volcanos. Nor are we to doubt of them from the enormity of their size. Why is it more surprising that Ætna should have increased to its present magnitude in the progress of ages, than that the *Monte Nuovo*, which is above one hundred and fifty feet high, and three miles in circumference, should have risen from the Lucrine Lake in one night? But I cannot join with Sir William Hamilton, when he says, " were he to establish a system, it would be,

be, that mountains are *produced by volcanos*, and not volcanos by mountains. Mountains, I mean the grand primordial and secondary chains, I verily believe, have nothing to do with volcanos. Volcanic mountains are merely the effects of probably very different causes. The seat of the fire is neither in the center nor towards the top of a volcano. It is fed, probably, from places far distant from its own immediate situation. It throws not only up its own contents, but, every observer knows the matter it has emitted for ages, in lavas, ashes, smoke, &c. could it be collected together, would suffice to form more than three such mountains, as the single cone, or mountain, of the existing volcano! Another proof, that the real seat of the fire of volcanos lies even greatly below the general level of the country, whence the mountain springs, is, that were it only at an inconsiderable depth below the basis of the mountain, the quantity of matter thrown up would soon leave so great a void immediately under it, that the mountain itself would undoubtedly sink in, and disappear after a few eruptions. The lavas alone of Ætna are commonly fifteen and twenty miles in length, six and seven miles in breadth, and fifty feet and more in depth. But the great eruptions seldom

seldom come from the upper crater: they generally proceed from the lateral parts. The huge mouth on the summit commonly serves as the chimney to the volcano. The inflamed matter is generally too heavy to mount to the upper regions. It finds a nearer, and a readier passage." *

Lava, however, as I have often repeated, is scarce, in comparison to other volcanic emissions. Portici and Torre del Greco were both destroyed in 1631, by torrents of *boiling water* having burst out of the mountain, with the lava. The first matter that issued from Vesuvius, and covered Herculaneum, was in the state of liquid mud. The spungy, frothy subsance, called pumice-stone, poured down in showers, overwhelmed Stabea and Pompeia, and kept them interred nearly seventeen hundred years. Tufa, which has for the chief article in its composition, that fine burnt matter, called *puzzolana*, and which blended with ejected water, great and small pumicestones, fragments of lava, and other burnt matter, and at last hardens into stone, forms considerably more than the whole of the bay of Naples. Marbles, granites, calcareous stones and shells, are frequently erupted. In short, the evidence is clear, that the matter of volcanos has often a very dis-

* Sir William Hamilton.

tant seat from the cone. But, however mountains of this nature may be progressively increased in circumference and elevation, it yet is to be believed, that this can only last so long as the subterraneous framing stands good. When that becomes exhausted, burnt, or crumbled away, the superstructure must tumble in, and leave those lakes and inverted cones, which are this day visible in the lake D'Agnano, the little forest of Astroni, and the Solfaterra. And hence, I cannot but persuade myself, that fire in volcanos is more *destructive* than creative; that a little gain in one place, is a great loss somewhere else; and that what we now see, owes its existence to the destruction of those lands which once might have filled the Mediterranean. Happy will it be, if Italy does not one day or other share a similar fate. That it is generally hollow, is probable. The whole country from Naples to Umbria is volcanic. Skirting the Apennines you have nothing but erupted substances. Alba Longa, one of the most ancient cities of Latium, said to be built by Ascanius, the son of Æneas, and which was taken and destroyed many centuries before Christ, was built upon the side of a volcanic mountain, the lava from which, in many parts, is not yet covered with vegetable earth. Even the famous Tiber, or I am greatly deceived

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in my examination, runs through the ancient crater of a volcano, as you draw near Otricoli, on the road from Rome to Loretto.

I will now release you from this tedious subject, with simply remarking, that notwithstanding all that has been said, it is denied by Faujas de St. Fond, that water coming in contact with lava in fusion, can occasion volcanic eruptions. "The water introduced to the furnace of a volcano," he says, "finding there a more *rarefied air*, would not produce an explosion." But, why is he to conclude, there is invariably rarefied air in the bowels of the earth? Volcanos are not always burning or raging; and it is a well known fact, that the greatest eruptions have generally happened after the longest state of rest. For instance, Vesuvius was tranquil for near four hundred years at one period, and then burst dreadfully out. "An experiment, however," he says "has been tried upon glass in fusion, that had lain in the crucible for hours, and that the water did not occasion the least fermentation; on the contrary, that it rolled on the surface of the glass, without even producing smoke, and after having become seemingly *red hot*, like metal in fusion, that it disappeared, without having occasioned the least explosion." All this is possible, but still

as we have more than one fact to put in opposition to this proof, I think we had better let the matter rest till further experiments are made, and be satisfied, at least for the present, with the contrary opinion to St. Fond. De Saussure gives us this brief classification of volcanic substances, and I mention it to you, as you may have occasion to refer to it, as you move about. 1. Lavas properly so called, are vitrified or melted stones, or earths: this class may be divided into regular formed lavas or basaltæ; irregular lavas, porous lavas, filamentous lavas, or pumicestones, and attenuated wrecks of these different matters or puzzolana. 2. Earths or stones, which are only half melted, and which in some degree preserve the form and character they possessed before they were attacked by the subterranean fire: such are the volcanic granites, with which the streets of Venice are paved, and in which are to be perceived fragments of quartz, and crystals of felt spar. 3. Stones, which have already surmounted, or eluded the action of the volcanic fires. Those, for example, which have been thrown out by subterraneous explosions, without suffering any alteration, such as the fragments of marble, that are picked upon the cone of Vesuvius. 4. The mixture of earth, stones, and lava, which, blended with boiling water, are

ejected from volcanos in a liquid form, and which subsequently acquiring a consistency, is tufa, peperino, or piperno. 5. The lavas, or other volcanic matters, which have been decomposed, either by the action of air, water, acids, or any other menstrua, such as the white lava, and other substances of the solfaterra and piscerilla. 6. Matters, which, after having been ejected from volcanos, in some one of the preceding forms, have been dissolved by water, and afterwards coagulated and crystallized into new forms, as the hydropales de Vicence, the Volcanic breccias of the valley D'Agno, and the crystallized substances in lavas.

There is, however, one unclassed volcanic ejection, which is, perhaps, the most striking phænomenon in nature. This is the *roche rouge* in Velay, in France. This basaltic rock is girt round by granite, and has no where near it the vestige of a crater, or of lava. It seems to have been driven through the mass of granite; and with fragments of the granite clinging to its sides, to have fixed itself, when at the enormous height of one hundred feet, and of the circumference of sixty feet. Nothing can be more extraordinary, than the sight of the granite girdle which thus surrounds it, to the height of seven

feet. * When or how the explosion took place, it is impossible to explain. The monument, however, is an awful one. A crystallized lava, with a zone of granite, is what must surprise, if not perplex every beholder.

Let us now have done, recollecting, however, before we part, that we are greatly indebted to all the natural destruction we have been talking of, for all the artificial preservation which now gives such delight to the artist, the antiquary, and the man of taste. When Greece was dismantled by the Romans, and Rome by the Goths and by Christians, had it not been for volcanos and earthquakes, the inestimable works of antiquity would have been wrested from us for ever. Bigotry and barbarism would have laid waste the works which had been the glory and the admiration of ages. But, Herculaneum and Pompeia were buried from ignorant research; Rome, likewise, in 345, had the earth shook upon some of the finest marbles, and hence they remain to us at this hour, and may continue to ages yet unborn.

* Faujas de Saint Fond.

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LETTER XLII.

THERE is no subject on which philosophers have so much differed, nor concerning which they probably have more widely departed from truth, than that of time. Placed on one of the smallest planets in the infinite system of the universe, and which is, as it were, lost amidst the innumerable multitude of worlds, the child of this little spot fixes with himself an absolute criterion for the commencement of time; and gives it the existence of but a few insignificant centuries. This idea, pressed upon us in our infancy, forms the cloud, which obscures the horizon of our first thoughts. The recent origin of time is the first link of that great chain of error which fetters reason. How truly might we join with the Egyptian priest, in his reply to Solon: "You still are infants, or are very like them. You know of nothing older than yourselves. Puffed up with your own superiority, you are ignorant of all that has gone before you: you even believe, that with you the world began to exist." The uncertain opinion

of nations, indeed, respecting their origin; the palpable evidence of their contradictions; and the distance there is between their general, as well as their comparative ideas, with respect to the antiquity of the earth, have, it must be confessed, afforded a plausible pretext for the doubtings of scepticism on the one hand, and to the assumption of infallibility on the other. But, the circumstances on which their respective pretensions are grounded, will, perhaps, be found to yield the strongest proofs of revolutions on the surface of this globe, and of the consequent close and regeneration of ages.

But, what is duration, or what is permanency? It is to common sense, nothing more than to exist free from destruction. Yet Locke says, "the more I endeavour to investigate the nature of time, the less I comprehend it. Time that unravels all things, is itself incomprehensible to me." All this mystery may, however, I conceive, be unravelled in a few words. The idea of duration is no other than what we have of a being, or action, which is neither discontinued nor destroyed.* The measure of duration, by the regular revolution of some sensible object, as the annual course of the sun, the monthly

* Buffier.

monthly of the moon, or the diurnal of a hand on the dial-plate of a clock, is time. These notions appear as clear as possible; and whoever should attempt to set them in a clearer light, would not act wiser than he who should endeavour to explain in what manner two and two make four, and not five.

Amidst the extravagant traditions with which nations are universally replete, we may always find one which goes back to creation, and systematically details the origin and progressive formation of the world. This first existence we analogically trace from our own infantine situation. As we have had a beginning, so must we suppose the system in which we are contained to have had its peculiar and appropriate birth. None, indeed, agree as to the epoch of this extraordinary occurrence. All, however, fix a moment, and calculate it exactly by ages. Thus, the greater part of modern historians and chronologers have divided the age of the world into six different epochas; but, even these historians and chronologers are not agreed between themselves with regard to the number of years contained in each interval. Those who place the creation six thousand years before the birth of Christ, make the interval between the creation

and

and the deluge to consist of 2,262 years. Those who make the age of the world at the birth of Christ only four thousand years, follow the chronology of the Hebrew text, and compute from the creation to the deluge 1,656 years; others make it 4,052; some only, 4,004; but others, 5,432 years. Thus, there is at least uncertainty on this head, and that too within the pale of Christianity.

In the more familiar, as well as in the more abstract investigation, we are apt to contract a habit of forcing our reason to submit to our prejudices. But, this we should guard against. Three principal means are given us to combat with advantage in such struggles. We have observation, we have reflection, and we have experience. Observation gathers facts, reflection combines them, and experience verifies them in their combination. Thus, astronomy joined to natural history, would guide us in our researches into the æras of the world; and would lead us to conclude, that its true age would much surprize us, if we could but pierce through the darkness of the long night that lies behind. "L'antiquité du monde, pouvait, êté beaucoup plus grande que nous saurions l'imaginer. Il n'est pas bien décidé encore si l'eclip-

l'ecliptique ne tend pas continuellement à s'approcher de l'Equateur. Des observations délicates ont paru prouver à un grand astronome que l'obliquité de l'ecliptique diminue d'une minute en un siècle; en sorte que pour arriver de l'obliquité actuelle à sa confusion avec l'Equateur, il lui faudrait plus de cent quarante mille ans. En suivant toujours la même proportion, et en supposant soixante minutes ou un degrè pour six mille ans, ce cercle aurait employè deux millions cent soixante mille ans à faire le tour entier en passant par les poles. Et qui pourrait prouver qu'il nà pas fait déja plusieurs revolutions? Je supprime ici certains faits d'Histoire Naturelle, qui semblent concourir avec ces présomptions astronomiques, à donner au monde une prodigieuse antiquitè, je voulais dire une effroyable antiquité." *

Ocellus Lucanus, by some held to be contemporary with Moses, but who, more probably, was a considerable number of years after him, or just before Plato, denied a creation; and was the first who insisted on the eternity of the world: "for if the world be made," says he, "it must follow the laws of other productions; it must grow from worse to better; from its infirm

* M. de Marian.

firm state to its ακμη or vigour; and so decline to its old age and dissolution. Now, the world always was as it is; there has never been the least decay in it, nor the least improvement in its perfection; it always stands at the same point, and so always must continue." Heraclitus, in the same manner, held, "that the world had no beginning in respect to time; but, that there is a mind, soul, or fire, which extends itself through all things, and has the power of producing and destroying, or rather altering the form of all things; and that nature is no where at rest, but in continual fluctuation of formation and decay." Cicero mentions a number of philosophers who were of the same opinion.

But, when this inferior world is said by these philosophers to be immortal, it is not to be understood of any state of nature, or of any single world, but of a succession of worlds, consequent one upon another. The ancients did not exclude the dissolution or renovation of the world. Stobæus and others tell us, that those who allowed the world to be perishable, did yet affirm it to be immortal; namely, by successive renovations. All material compositions are dissoluble, and again capable of re-composition. The doctrine of Aristotle, of an eternal earth, is baseless.

baseless. * It is natural to the mind of man to conceive that which is compound to have been once more simple; for a thing that consists of a multitude of pieces, aptly joined, we cannot but conceive to have had those pieces at one time or other put together. It were hard to conceive an eternal house, whose materials were never asunder, but always in the form of an house. It were as hard to conceive an eternal animal or plant. It may be said, there is not the same reason for natural things as for artificial. Artificial things could not have been from eternity, because they suppose man, by whose art they were made, and whatsoever hath any thing before it, is not eternal. But, may not the same thing be said of natural things? Do not most of them require the action of the sun? Do not they require longer preparation than any artificial things do? Years, ages would be necessary for the concretion and maturation of metals and minerals: stones themselves were once liquid or fluid masses, and all vegetable productions require heat. Thus, the earth, under its present form and constitution, could no more be eternal, than a statue or temple, or any work of art. And to this effect argues even Lucretius, who attributed to matter as much as any materialist.

Præterea

* Burnet.

Præterea, si nulla fuit genitalis origo
Terraï et cœli, semperque æterna fuere,
Cur supera bellum Thebanum et funera Trojæ
Non alias alii quoque res cecinere poetæ? *

This singular but nervous poet pretended to materialize the Divinity, at the same time that he deified matter. To his Alma Venus he attributed the creation of the world.

It has long been a maxim of much authority, that it is good to be neither too sceptical, so as to need burning before we are convinced the fire is hot; nor too credulous, as those who see nothing but what is invisible, and believe nothing but what is incredible. Ages are but as instants, probably, in the immeasurable duration of time; and the existence of the most ancient of our recorded nations occupies but a few of those instants. Whole people, with their most solid monuments, pass away, and are buried in everlasting night. In vain are they to be searched for, in the place of their momentary abode. They are lost,—and are to us as if they had never been. Even the disasters which have destroyed more recent countries, have plunged the wreck of the miserable inhabitants

* De Rerum Naturæ, lib. 5, v. 325.

bitants into a state of chearless nakedness, where their descendants soon have lost the memory of the fatal catastrophe. Nothing remained but terror and an awful idea of a general destruction; which time and the fluctuations of mankind have altered in the course of generations. Thus the uncertain opinions, and the contradictions of men, exemplified in their ceremonies of religion, are merely, perhaps, the broken and imperfect parts of the chain of ancient events. They are nothing but extravagancies gleaned from the indistinct traditions of the disasters of the world.

But how many ages must have glided away before stones, marbles, granites, &c. could have been formed? These are not ephemera. They do not rise with the spring, and fall with the autumn. When I look at these, how can I imagine duration and eternity to have had a limitation of 6000 years? My conception of the origin of these things, as well as of dependent beings, must inlarge. I cannot be satisfied with a boundary which seems to have been inadequate to the purposes and to the energy of nature. Infinite space and eternal duration, I readily confess, are above our finite capacities. Difficulties insurmountable must attend such indefinite ideas.

But,

But, as in all other cases, one line is left us in preference to another, and that is, to adhere to that mode of reasoning which is liable to the fewest objections. Thus, we may be assured, though there has been a beginning, and consequently a relative commencement of time, yet there must have been an eternity before that commencement. Though we go back as far as thought can reach, yet wherever we stop, an eternity is beyond it. The æra of creation, therefore, is not to be ascertained. Its certainty, indeed, is not lessened by the impervious gloom which surrounds it. But, the moment when the almighty fiat passed must have been anterior to that which we are given to understand, to have been the first in the circle of duration.

When we contemplate this present earth, we are taught to believe it was formed as it is, and that all the continents were created at the same time. The same we are taught to believe of the islands, the seas, and the mountains: we are scarcely allowed to admit of any variation whatever in their figure or dimensions. And yet that *all* hath been under the waters, is evident. Should we not, therefore, consider the present as a new world; but, at the same time, as one become new, at the expence of an older world, which is lost?

lost? Every part of the earth shews it has been repeatedly regenerated.

Creation is the producing something out of nothing, which, strictly and properly speaking, is the effect of the power of God alone, all other creations being only transformations, or change of shape. Creation then being thus physically incomprehensible, how wild in us to attempt an investigation of it! But, it is said, the origin and progress of creation was revealed to the lawgiver of the Jewish race. Now to reveal, is the same thing as to explain or to discover. But, to reveal a mystery, so as to leave it still a mystery, is a flat contradiction in terms, and an absolute solecism. It is an explication that wraps up and involves, what it pretends to unfold; it is a discovery, which conceals. The wise lawgiver himself, indeed, who on all occasions was careful in discriminating between his own thoughts, and those which were communicated to him by God, is silent on this subject. He no where says, he received the account, which he has given us of the creation and fall of man, from God immediately. The conclusion, is therefore, fairly to be drawn, that it is the best and most accurate he was enabled to collect and put together, from tradition. Thus, though Moses wrote the Books of Genesis,

how could he write the history of the creation, before there was a man to see this work, and transmit an account of it to posterity? In the Book of Job, the Almighty is introduced as challenging the whole of the human race, to tell the time when, or the manner how this stupendous work was executed: "Where wast thou when I laid the foundations of the earth? Declare if thou hast understanding."

On the subject of the creation, Moses, it is true, says, the terrestrial globe had a beginning; but this beginning he deduces from certain substances, under certain forms, and the whole resulting from anterior causes. The phænomena of these causes he does not indicate to us. Not having ventured, therefore, to assign a determinate age to the materials of which this earth is composed, it cannot be considered as derogatory to him in his character of historian and chronologist, to believe, that he himself held the earth to be older than the æra which he affixed for the existence of the antediluvian world. The chaos out of which every thing was created, he very expressly mentions. Now that chaos, which could have admitted of such variety of subsequent material forms, must have been the aggregate of matter itself; and consequently, Moses allowing

allowing the chaos to have been in existence, must have allowed of the existence of matter previous to the creation.

But, the idea of a chaos, or mass of all sorts of small particles of matter mixed together and floating in confusion, is not very easily reconcileable to reason, for it is impossible that the surface of this mass should be of such a form and figure as the surface of our present earth.* A fluid body, we know, whether it be water or any thing else, whether it be sand or fine powder, will suffer no hollowness within it; on the contrary, it will always cast itself into a smooth and spherical surface; and if any parts by chance, or by agitation, become higher than the rest, they will not continue so, but will glide down again every way, till they all come to make a surface of the same height, and of the same distance every where, from the center of their gravity. A mountain of fluid water is a thing impossible in nature, and where there are no mountains there are no vallies. So also a den, or cave, within the water, that hath no walls but the liquid element, is a structure unknown to art or nature; all things there, must be full within, and even and level without.

* Burnet.

without. But, is this the form of our earth, which is neither regularly made within nor without? The surface is broken into all sorts of inequalities; huge mountains lying in lumps or clusters, heaped one upon another; sometimes extended in long ridges or chains for many hundred miles in length; every continent, almost every island possessing them. Then for the interior parts all are cavities, empty places, dens, and broken holes, like the wrecks of a great ruin. In passing from its liquid state to its concretion, to its constancy and firmness, it could not assume another surface: for as, when water congeals into ice, the surface of the ice is smooth and level as the surface of the water was before; so metals, or any other substances melted, always settle into the same form which they had, when they were last liquid, and are always solid within, and smooth without, unless they be cast in a mould, that hinders the motion and flux of the parts. The chaos, therefore, out of which this earth was formed, cannot be very readily conceived to have been in a fluid state.

When Moses speaks of the creation, he with an ability adequate to his great calling, confines himself within the bounds of human knowledge, and checks his mind from straying into the regions

gions of metaphysics. To others he left the attempt of accounting for the great Creator's act in bringing something out of nothing. He did not presume to soar into boundless space, and from invisibility to draw forth a material world. In the simplicity of ignorance, but with the sublimity of a powerful mind, he ascended not above what is seen, but, in words which have never been exceeded by poet or philosopher, says, "God said, let it be, and it was." Had Moses, contrary to this wise and humble course, endeavoured to unfold all the phænomena of the true system of the world, in what light would he have beeen regarded by the illiterate nation of the Hebrews? But, he studiously refrained from perplexing his people with physiological notions. He saw his ground; and whatever his own intelligence might have been, he perceived the hazard of talking to such men of planetary vortices, of the centrality of the sun, or of a world in the moon.

Moses evidently accommodated himself to the present form of the earth, and to that which was before the eyes of the people to whom he wrote. But it is clear he did not pretend to give a true physical account of its origin; or philosophically, or by astronomy, endeavour to support it. The

ancient Fathers, when they answer the Heathens, assert this; and the narrative itself bears evident marks of a condescension to vulgar notions.* It is a narration suited to the capacity of the people. Moreover, this vulgar stile is often made use of in the Scriptures. How freely and unconcernedly does the Bible speak of God Almighty, "of his passions, local motions, the parts and members of his body?" Now if this liberty be taken with God himself, much more may it be taken as to his works. And accordingly we see, what motion the Scripture gives to the sun, what figure to the earth, what figure to the heavens: all according to the appearance of sense and of popular credulity. This unfortunately hath often been mistaken for philosophical truth, and thus given birth to the most vulgar conceptions. Hence the *Anthropomorphites*, who contended for the human shape of God; and the Christian Fathers denying there were Antipodes. The making God to work by the day, and in six days to finish his labour, is surely the excess of the vulgar stile.

The object of Moses was to support his divine legation, and consequently he was obliged to adapt his language to the senses of a people, who had

* Burnet.

had not yet learnt to make use of their reason any other way, than from the appearance of things, and to the exposition of a subject, too sublime for common capacities in any age, and which had only been attempted in Egypt, as some of the Israelites themselves, perhaps, were acquainted with. The Hebrews at all times were accustomed to express the extraordinary works of God by figurative expressions. To measure them, therefore, by the standard of an allegorical hypothesis, would be the best way of freeing Moses from those difficulties which common apprehensions cast upon him. The whole history of the Fall, however politically Moses may have darkened it, is but hieroglyphick, put into writing, to represent the πλημμυρησις, or fall of the soul when it was embodied in some pristine seat. St. Paul himself, in the tenth of the first of the Corinthians, when speaking of several actions in the history of the Old Testament, of the Israelites passing through the Red Sea, drinking out of the rock, &c. says, "which things happened, τυπικως, by way of type.

The sacred writers in general, as they addressed themselves to ignorant men, spoke and wrote in a language, in which they had a chance to be generally understood; hence the immoveability

of the earth, and the motion of the sun around it, are frequently referred to in Scripture. Hence Moses calls the moon a great light, as well as the luminary from which she derives her radience; and hence the Jewish writers suppose a solid firmament above the atmosphere, to which stars are fastened; and a vast reservoir of water above that firmament, which occasionally finds its way downwards through sluices and cataracts. Every author, whether sacred or profane, who writes for the instruction of mankind, must speak in the language of his own times; and if Moses had revealed to his barbarous countrymen the position of the sun in the center of the universe, with the centripetal and centrifugal forces of the planets, which moved around him, he would have passed for a madman instead of a prophet.* Yet such has been the desire to accommodate religion to the philosophical and fashionable taste of the times, that the Prophets and Apostles have been compelled to give their sanctions to every theory of physics or metaphysics that has prevailed in the world. The fathers of the church were Platonists or Peripatetics, according as these different systems prevailed. The Abbè de la Pluche made Moses a disciple of Des Cartes, and discovered the vortices and subtile matter in the first chapter of Genesis. Since that period, attempts have

* Review.

have been made to press him to the side of Newtonianism; though it is no discredit to his understanding or his literature, that he never read Newton's Principia, nor looked through Herschell's telescope.

As we are expected to understand literally Moses's account of the creation, so we are required literally to believe Adam to have been the first man, and to have been the father of the whole human race. But there are several passages in the writings of Moses, which cannot be easily explained on the supposition of there having been no men in the world before Adam. The individual Adam, therefore, may reasonably be supposed not to have been the sole father of the human species; but merely the founder of the original Jewish tribes of Cain, of Abel, and of Seth. The Gentiles, who are often called sons of men, had their line of descent from other sources. They were the descendants of the Aborigines, whose original fathers have not been mentioned. If we take the text literally, and suppose no men in the world but those who descended from Adam, we must believe there were none of the human race alive when Seth was born, except Adam, Eve, and Cain; for Abel left no issue; and Adam had none betwixt

Abel

Abel and Seth. After Seth, he had sons and daughters. Yet, when Cain was punished for the murder of his brother, he is said to go out a fugitive from society; and when he committed the murder, he is said to have gone into the field to do it, that is, from company, though it would seem that Adam and Eve only were in being: and when he was sent to Nod, eastward from Eden, which was so called in those days, he took his wife with him. Now, whence was this female, if Adam had no daughters until after Seth was born, as it is plain he had not, otherwise they would have been recorded before, as well as after Seth's birth? If it should be objected, that he might have had daughters sooner, though they are not mentioned, this is begging the question; for, if Adam might have had daughters, and Moses has been silent about them, is not the silence of Moses about any other men formed before Adam, alleged as the reason why there could not have been any? Cain's wife, therefore, must have been from among the Gentiles. Cain was a tiller of the ground, but whence had he the instruments of tillage, unless some artificers were before him to make them? He was likewise afraid that every one who met him, should slay him; though God, to prevent this, had set a mark upon him, and pronounced vengeance

geance against those who should do it. He after this, upon the birth of his first son, built a city, which he called, after his name, Enoch. The distinguishing the city by a name, pre-supposes there were cities of other names in the world; as well as his going to the Land of Nod, shews there were distinct regions and nations at that time. But, upon the supposition that none were in that country but Cain, who were to slay him? Who were to build the city? or when the city was built, who were to inhabit it?

From the palpable conclusion which must be drawn from premises of this nature, and which are only contradictory, when too literally insisted upon, it would appear convincing, that Moses never intended to give an historic narrative of the events of the whole world, placed in the actual periods of their existence, and arranged in the real series of true time. Neither can it be otherwise imagined, than that, by Adam and Eve, he did not mean the primogenial parents of all the earth; but merely the first of the holy race; the original founders of the Jews, who would not deign to proceed from that stock which the common herd of mankind came from, but would have an origin more immediately from the Deity, to imprint a more peculiar character of dignity and

and holiness upon themselves The whole of Moses's account is mystical and traditionary. Otherwise, must we not suppose that a chosen being, such as Eve, who had so great a price set upon her good behaviour, as the salvation of all mankind, would have been providentially guarded and protected? Nay, farther, would it not seem to reflect upon the wisdom and goodness of God himself, to suffer his whole creation, which he had been so many days in making, to be ruined in a moment, by a malicious spirit; and when the fatal miscarriage, could have been so easily prevented?

Symbols were familiar in the days of Moses: they were in common use among the Egyptians. The Tree of Knowledge of Good and Evil, therefore, which Eve is represented as not having been able to refrain from, was probably a mythic tree, representing, in the luxuriancy of its branches, the wildness of men's opinions; and of its tempting but poisonous fruit, the mischievous effects of being seduced by the vanity of false learning, to become wise above the station prepared for us. The Tree of Life, or the symbol of the doctrine of immortality, may be considered in the same light. All metaphysical disquisitions into the immateriality and immortality of the soul were to be guarded against, as adverse to the

spirit of a theocracy, which confines all rewards and punishments within the verge of the present state and present life. Thus, the prohibition against the eating the apple, "In the day that ye eat thereof, then your eyes shall be opened, and ye shall be as gods, knowing good and evil," must be looked upon as a veiled part of the apologue; * for it never could be supposed, that the accretion of any matter, especially of divisible matter, taken and secreted as food, could in fact give immortality to the immaterial, indivisible part of man, to the living soul, which was after God's image; and it will of course relieve the account from historical and natural difficulties, and will give it a precise meaning.

But where was the paradise, in which Adam and Eve are supposed to have been placed immediately after their creation; and where did these mysterious transactions come to pass? Various are the opinions, and wild the conjectures upon this subject. Paradise has been placed in the third heaven, in the orb of the moon, in the moon itself, in the middle region of the air, above the earth, under the earth, in the place possessed by the Caspian Sea; even in the regions of the arctic pole. "This globe," says Linnæus,

* Pownal.

næus, " was originally covered by the sea, excepting a particular spot, or small island, situated under the Equator, called Paradise, where Adam and Eve were created, and in which all the species of vegetables were placed, one only single sexual pair of every species of living things; and these were prevented from escaping by the surrounding ocean until they had received their proper names from Adam. In this insulated spot, each vegetable met with its appropriate soil, and every animal found its proper climate, because it was placed under the Line, and its beautiful plains were adorned with a lofty mountain, on the top, sides, and base of which vegetables might grow, and animals feed on the soils peculiar to frigid, temperate, and torrid zones. In process of time, and in consequence of certain unknown causes, the dry land, or island, expanded itself, and the sea as gradually retreated, till the whole terraqueous globe on which we walk and sail, assumed that form which it has at present "

Burnet tells us, there were two opinions of paradise which should be avoided; one, that placed it in the extramundane regions, or in the air, or in the moon; and the other, that makes it so inconsiderable, as to be confined to a little spot of ground

ground in Mesopotamia, or some other country of Asia. "On this question," says he, "seeing that neither theory nor Scripture doth determine where the place of paradise was, nor in which of the hemispheres, we must in our own defence appeal to antiquity; for I know of no other guide but Scripture, reason, and ancient tradition; and where the two former are silent, it seems very reasonable to consult the latter." The Jews place paradise under the Equinoctial, and this, as Eben Ezra tells us, because they supposed the days and nights always equal in paradise. The Heathen poets and philosophers had a notion of many paradises; and what is remarkable, they placed them generally, if not all of them, out of this continent, in *another hemisphere*;—the garden of the Hesperides, the Fortunate Islands, the Elysian Fields, Ogygia, and Toprabane, with other such like. The oldest Sanscreet writings speak of part of Scythia as a paradise. The inferior heaven of the God Endra, where "it becomes pure spirit to feed on balmy air, and in a forest blooming with trees of life," is described as being situated in the mountains of Heemekot, which is the Sanscreet name of Imaüs, "than which the universe contains not a more excellent place for the successful

cessful devotion of the pious, and where the Brahmin religion once flourished in the greatest vigour."

The Christian fathers, again, disputed whether paradise was corporeal, or only intellectual and allegorical. They none of them placed it in any determinate region of our continent, Asia, Africa, or Europe. Those who thought it corporeal, placed it high in the air, and beyond the ocean. It was, say they, in another world; and the inhabitants of that other world they called *Antichthones*. Adam, when he was turned out of paradise, was, according to them, brought into our earth, or into our region of it. Thus, says Tertullian, "Paradise by the torrid zone, as by a wall of fire, was severed from the communication and knowledge of our world." This was the flaming sword. And hence old writers, from tradition, say, that "interposito oceano ab orbe nostro, vel a zona nostra, habitabili secretus."

But, more of this hereafter. The broad and legible hand of nature shews, there is nothing terrestrial which is durable, much less eternal. For although no part of nature can, to our know-

knowledge be annihilated, yet there is no part that is not subject to the laws of decomposition; to the disunion of its constituent principles, and to the positive destruction of its form and volume. The mountain of granite is doomed to a separation of its parts, equally with the flower, which brightens with the morn, and droops with the decline of the evening sun. In this sense, likewise, we must interpret the heathen philosophers of antiquity. When they spoke of the eternity of the world, they meant the eternity of the universe. The universe, they took in our unbounded sense of the word. This, they said, was eternal. But the earth they conceived formed. Nor is it strange they should have done so: the eternity of the earth, is at least as incomprehensible as the creation of the earth. Can we conceive mundane existence, without mundane commencement? But however this may be, Moses, of whom we are now particularly speaking, shews clearly in different parts of his writings, that the sketch of history which he gave the Israelites, was little more than a brief compilation from foreign memoirs. Simple oral tradition, could never have so accurately retained the various epochs, dates, names of places, names of people, and

names of cities, which we find so methodically arranged in the Pentateuch. Though written more than 3000 years ago, it bears every mark of historical precision. The order he has given his narrative, is simply that which was conformable to the *cyclic* ideas of the people he lived amongst. But he mentions *books* as existing before his time; and the City of Archives, or *Cariath Sépher*, as a city well known by the Israelites, in the Land of Canaan. Voltaire indeed says, that alphabetic writing was not known in the days of Moses, and that the Israelites, the Phœnicians, and the Egyptians, used nothing but hieroglyphics. But *Sanconiatho*, who was supposed to have lived about the time of Moses, which, however, I do not vouch, says, he took great part of his history from the writings of *Thot*, who flourished 800 years before him. This, the most curious proof we have of the antiquity of alphabetic writing (not that I shall not have more to give you, before we have done), is sufficient to controvert this hasty and unsupported assertion of Voltaire. But I do not presume to say, that Moses's historical compositions are equal to those of Thucydides or Pliny, or others of a more modern date.

At

At the same time I must be permitted to believe, that the more recent writers by profession, do not so greatly excel the venerable Hebrew model, which they had first to study, and afterwards to improve upon, in the succession of ages. The author who for a series of years, has no other occupation than that of gathering the flowers of others thoughts, for the history of some certain fact, may undoubtedly surpass the summary commentaries of an indefatigable legislator, who, if any, had less time to throw away in the recording of what happened to him and to his people, than even a Cæsar or a Frederick. To do, and to record, and both with ability, falls to the lot of few.

LETTER XLIII.

THE style of language of all barbarous nations upon earth, both ancient and modern, for nature is ever uniform, is concise and figurative. It is almost a speaking hieroglyphic.* Hence the scriptures are easily to be explained. "Thunder and tempestuous winds," are put for hostile nations. "Stars falling from the "firmament"—the destruction of the nobles. "Lyons, bears, leopards, goats"—leaders of armies, conquerors, and founders of empire. The Jews, indeed, above all others, conceiving themselves a chosen race, and distinguished by God Almighty, by their descent from Adam, and despising the Gentiles as a species scarcely human, dealt out these figures with a most lavish hand. The sons of men, they called sinners, and beasts. Themselves they honoured with the appellation of the sons of God, and the country wherein they lived, that of the Holy Land. But in fact, there are various things in the scriptures, both moral, theological,

* Warburton.

cal, and natural, wherein we recede from the letter, when it is manifestly contrary to the dictates of reason. Our Saviour says, "If thy "right eye offend thee, pluck it out. If thy right hand offend thee, cut it off." There is no man who thinks himself obliged to the literal practice of this doctrine. * Again, "if any man will sue thee at law, and take away thy coat, let him have thy cloak also." And yet there is no christian so good natured as to practice this; nor any casuist so rigid, as to enjoin it. Other instances may be found in our Saviour's Sermon upon the Mount, in which we do not scruple to lay aside the letter, when it is judged contrary to the light of nature, or impracticable in human society.

These doctrines, particularly of the New Testament, it is evident, were figuratively meant to regulate the duties, not of mankind generally, but of individuals towards each other; they were addressed to men, who were to be dispersed over the earth, and who by their patience, moderation, gentleness, and humility, were to convert men to the christian religion, and to triumph over the malice of their enemies; and so taken, must be acknowledged to be full

* Burnet.

of wisdom and of goodness. To interpret them differently, would be to deviate from the benign intention of the Gospel. Nor can greater injury or injustice be done to sacred history, than to give such representations of things recorded in them, as make them unintelligible and incredible; and on the other hand, we cannot deserve better of religion, than by giving such fair accounts of all things proposed by them, as may silence the cavils of Atheists; satisfy the inquisitive, and recommend them to the belief and acceptance of all reasonable persons. The zealous advocates of true religion would not proscribe all use of reasoning. That would be to confound theology with superstition and barbarism. And yet there are those, who highly valuing themselves for being rational, and by virtue of it, religious; are yet ever contriving how to hinder the free exercise of reason in religious matters; as if reason and religion were irreconcileable; and that the method God has proposed to us for the discovery of all other truths, was the most certain way of confounding religious truth.

But the right of appealing to reason, a right which cannot be denied, being liberally granted, philosophy will then be found to have

have for its object, an innocent and highly useful inquiry into the nature and ground of our opinions and principles. True philosophy improves the faculties; and as it increases the activity of our minds, it must be of eminent use in ascertaining and illustrating divine truth, and in preparing us for receiving it. Thus, the savage receives divine truths carelessly, hears them with indifference, apprehends them confusedly, and suffers them soon to be obliterated from his memory. But a *Newton* listens to them attentively, weighs them deliberately, comprehends them accurately, and keeps them in careful remembrance.* In short, nothing can secure the mind from error and imposture, but the precision arising from a candid philosophical spirit, which admits no terms that are not clear; no premises that are not evident; and no conclusions that do not intuitively follow premises well ascertained.

It has been laid down by Aristotle, as the proper way of reasoning from authority, that what seems true to some wise men, may upon that account be esteemed somewhat probable: what is believed by most wise men, hath a further degree of probability: what most

* Morgan.

men, both wise and unwise, do assent to, is yet more probable; but what all men have generally consented to, hath for it the highest degree of evidence of this kind, that any thing is capable of; and that it must be consequently monstrous arrogance and folly, for any single persons, to prefer their own judgment to the general suffrage of mankind. At first sight, this appears reasonable, if not irrefragable. But in considering it in all its parts and ramifications, it will be found to be a rule more specious than rational or just. What extravagant fabrications of faith, have different æras of the world produced; and for ages, how enthusiastically have they been believed! The general currency of belief at one moment, is not the standard of credulity for another. Thus, and with reverence I say it, there is a great difference between scripture with philosophy on its side, and scripture with philosophy against it, when the question is concerning the *natural world*. Passages unintelligible, and inconsistent with science and philosophical truth, are surely not to be contended for, though they have the sanction of time, and of general acquiescence.

In

In the first ages of the church, those of the primitive christians, who maintained liberty of conscience, and the right of private judgment, against those who pretended to be of the catholic church, were branded as heretics; called in derision by the general name of *gnostics*, because they pretended to be wiser than the church, and claimed a right of judging for themselves; for which insolence and rebellion, they were doomed to eternal damnation, without any hope or possibility of pardon. Upon this principle, every man who was not as credulous as his neighbour, was, in the language of the day, an infidel; as if historical credulity was the justifying faith of scripture; and incredulity the sin against the Holy Ghost. Yet the difference between the style of the Old and the New Testament,* is so very remarkable, that one of the greatest sects in the primitive times, did upon this very ground found a heresy of two Gods: the one evil, fierce and cruel, whom they called the God of the Old Testament; the other good, kind, and merciful, whom they called the God of the New Testament. Among such contradictions, therefore, must not the judgment be employed? When scripture is meant to be understood, it clearly comes within the reach of

* Archbishop Tillotson.

of the human understanding. When it is otherwise, it is not imposed upon us, to treasure up, and to insist upon incongruities. "The economy of the law," says Clemens of Alexandria, "is typical and prophetical: Moses and the Prophets wrote all in parables." So Tertullian: "The law, says he, is spiritual and prophetical; and almost in all points figurative." Le Clerc observes, that "the Fathers did not "content themselves with interpreting the Old "Testament allegorically, but they did the same as to the New"—Origen was celebrated for this allegorical method; and as he was esteemed the greatest champion of christianity, next to the Apostles, and since what he says was not only his own, but the sense of the then church, his authority must be considered as of importance. "If we adhere," says he, "to the letter, or un- "derstand what is written in the law of God, as "the Jews do, in the common acceptation of "the words, I blush to own, that God ever "gave such laws, for mere human constitu- "tions, as those of the Romans, Athenians, and "Lacedemonians, will seem more reasonable "and proper; but, if the law of God is to be "understood in the sense the church teaches, "then truly it exceeds all human ordinances. "How can we be edified, in reading that so

"great

"great a patriarch as Abraham, not only lied, "to King Abimelech, but also betrayed to him "the chastity of his wife? What instruction "can we reap from the wife of so great a patri-"arch, if we think she was exposed to be de-"bauched by her husband's contrivance? Let "the Jews believe such things, and those with "them, who are greater friends to the letter "than to the spirit." St. Austin also, a man of eminent consideration among the Fathers, says, "We must not take the story of Jacob's "cheating his father, by personating his bro-"ther Esau, literally; lest the scripture should "seem to encourage lying." And speaking of Jesus cursing the fig-tree, he says, hoc factum, nisi figuratum stultum invenitur.

This typical, figurative, and allegorical sense of Moses and the Prophets, had not, it is said, been known or heard of by the Jews till after their captivity. It was from the time of Ezra or Esdras, this figurative interpretation of the law and the Prophets came into vogue; and was generally received by the rabbis or jewish doctors, down to our Saviour's time, and about a century lower. The jewish books written before and since the days of Esdras, say they, are so many clear records, or standing memorials,

of

of the truth of this. Before this period, no jewish writer, priest, or prophet, had ever mentioned a word of a conflagration of the world; a general resurrection; a judgment of good and bad men; and a consequent future state of rewards and punishments. And this may be accounted for, by the common people having lost their original language, after the captivity. They then were obliged to receive both the true reading and the sense of their ancient sacred books from their learned doctors, the *Masorites*, and *Cabbalists*;* which gave these learned men an opportunity to advance and propagate what doctrines they pleased, under the authority of Moses and the Prophets; and because they could not pretend to support such new doctrines from the original, proper, and literal sense of the text, they set up an oral tradition, to justify their arbitrary interpretation.

In opposition to this, it is however said, that the Pentateuch, written by Moses himself, was kept with the utmost care in the ark and the temple, until the demolition of that fabric. During this period of time, the copies transcribed from the original, were corrected by it, and must have been as perfect as copies could be. At the captivity, as the people were carried away from

* Dr. Prideaux.

from their own country, and had assurances given them by the Prophets of a restoration, it was absolutely necessary, to preserve with all possible scrupulosity, the *authentic copies* not only of the Pentateuch, but of the Prophecies, and other sacred writings, because, on the former depended all the knowledge of the law, and all the distinctions of the tribes and of particular families; and on the latter, all their hopes of a return to their own country, together with the happy and triumphant condition promised them under the Messiah. After the captivity, which lasted but 70 years, the Canon of the Old Testament was formed, and a copy of the scriptures authenticated, by which all others were corrected. The manuscripts, indeed, whence our present editions of the scriptures were printed, contained many thousand various readings; the New Testament alone, 30,000. But as the errors of ne manuscript were easily set right by another, and by the sense and context, the whole, as they are published at present, are clogged with no such manifold variety of readings. It is true, they are given in some editions, merely for the use of the curious and learned. But after all the noise made about them, they are little more than literal and involuntary errors of the transcribers, incapable of

of serving any party. Had the same scrupulous care been taken to collate many of the manuscripts of the classics, their various readings would probably have been found to amount to more.

It is a fact well known, that the Jews have no ancient learning, unless by way of *tradition*.* There is not a book extant in their language, excepting the Canon of the Old Testament, that hath not been written since our Saviour's time. Their several captivities, dispersions, and desolations, occasioned this. In the Babylonish captivity, their temple was ransacked, and they did not preserve, as it is thought, so much as the Autograph, or original manuscript of the law; nor the books of those of their prophets that were then extant, and kept in their temple; and at their return from the captivity, after 70 years, they seem to have so much forgot their native language, that the laws were obliged to be interpreted to them in Chaldaic, after they were read in Hebrew, for so, says Burnet, I understand that interpretation in Nehemiah, chap. 8. v. 7. 8. "And Ezra, &c. and the Levites, caused the "people to understand the law. So they read in "the book, the law of God distinctly, and gave "the

* Burnet.

"the sense, and caused them to understand "the reading." Now, whether Burnet's be the just conclusion or not, is a point of no very great importance. These are the words: "When the people gathered themselves together, and Ezra the scribe, agreeably to their desire, had brought to them the book of the law of Moses, which the Lord had commanded to Israel." The words evidently speak of an interpretation: and whether the interpretation was from one language to another; or whether it was simply the exposition and elucidation of certain obscure and figurative sentences, the difficulty rests precisely upon the same grounds. Something involved, was necessarily to be made clear. Something incomprehensible, was to be reduced to the standard of common apprehension.

From these sacred documents, it is believed (however they may have been handed down), that the Septuagint, or translation of the seventy two interpreters was made, by order of Ptolemy Philadelphus, King of Egypt, 111 years before Christ. From the Greek text of the Septuagint, the vulgate, or most ancient Latin translation of the bible, was compiled almost word for word; and from these two, with incidental collations

collations with the original Hebrew, our present Canon in general is supposed to be derived. The variety of accidents to which such a work was liable, in the progress of so many ages, renders it essential in the eye of reason, that we should not be implicit in our belief of every part of it. We may, indeed, depend upon tradition, or human testimony, that this or that communication had been made by providence to mankind. But, to be believed, it must appear, that the substance of such revelation was morally fit and reasonable in the nature of the thing, antecedent to, and abstracted from any such tradition or human testimony. This is the only infallible criterion. And thus St. Paul, the great and only Apostle of the Gentiles, in preaching and publishing the religion of God and nature, made no use of miraculous operations, or supernatural agencies. He appeals to nature and to reason for the truth of Christ's doctrine, and declares that every man shall be judged by the law he had been under, whether the written law of the Jews, or the common law of nature, as appearing in the works of the creation.

Under the sanction of such great authority, then, may we not be permitted to believe, that the

he Hebrew historians were too apt to ascribe he most natural events to supernatural causes; nd that they affected to relate nothing but mi-acles in favor of their own nation? Thus, for nstance, the history of the Exodus and conquest f Canaan relates to things done about six hun-red years before Homer's time, and is written omewhat in the same oratorial and dramatic way. For should we take this drama in the obvious nd literal sense, we must suppose Moses to ave been, if possible, a more fabulous, roman-ic writer, than Homer; Æsop, Ovid, or any f the heathen poets and mythologists. We nust suppose that in those days God appeared, poke, and acted like other men; that he con-versed intimately and familiarly with Moses; hat he went out of Egypt at the head of the sraelitish army, and walked with them hrough the red sea; that he travelled with hem up and down for 40 years in the Wilder-ness, and always at the call of Moses; that in a visible manner he always was present, and gave Moses the word of command when they should march, and when they should halt; and marked out every foot of ground from time to time for the encampments of their respective tribes. Nay, in the literal sense of the story, such was the interest of Moses with God, that he could

make him do whatever he pleased; he often changed his mind, when he had resolved to destory the people; and prevailed with him to go farther, when he had resolved to leave them, and go no farther. In a word, Moses and the Prophets are to be admired, as historians, orators and poets; but, as to their infallibility, excepting in a figurative sense, or when extraordinarily employed, there we have reason to doubt, however we may reverence them.

From this plain, and in no respect forced, chain of reasoning, it will readily occur, that if Moses, in tracing the genealogy of his ancestors, in relating the most remarkable transactions of their lives, and in narrating the situation and progress of the Israelites under his command, could so far deviate into the regions of allegory and fancy;—we may, without any fear of the reproach of irreligious scepticism, assume that the paradise mentioned by him, was either the symbol of some divine truth, or that it was not to be sought for on the present earth, as now constituted; but in an anterior world, of which this is but the ruin. And we may likewise believe, that something more is meant than what the words literally convey, of morality, and a knowledge of good and evil growing upon

upon trees; or of the Euphrates, the Tigris, the Nile and the Ganges, having their origin in an Eden, of which there are no traces upon the globe. In regard to the serpent, who in this celestial spot worked upon the weak minds of our First Parents, he has long ago been looked upon as the wayward spirit of nature, operating with the energy of animal passions and appetites, against the moral and divine truths implanted in the heart of man. And yet Adam and Eve are reported to have had frequent personal conversations with him, and those too in a language which all three must have had intuitively bestowed upon them by providence. Moreover, Adam is said to have given names to all living creatures, to every beast of the field, and to every bird of the air, as they were brought before him; and that too from all parts of the world; in the course of a few hours, and after a mature consideration of their temper and faculties. But, it is asked, how the fishes of the sea could have been brought to him in the garden of Eden to receive their names? This indeed, is not insisted upon, for it is remarkable, that there are no names of particular fishes to be found in the bible. From all this, however, says Tindall, some would be almost apt to imagine that the author of the book of Genesis thought

that *ideas* had *words* naturally fixed to them, and not by consent; otherwise, says he, how can we account for his relating that God brought all animals before Adam, as soon as he was created, to give them names; and that "whatsoever Adam called every living creature, that was the name thereof." But, had Moses thought so, he would not have been singular; for *Herodotus*, many years after him, not only was of that opinion, but still more absurdly believed, "that *ideas* had *words* naturally affixed to them," as appears from his famous story of Psammetichus and the two boys. *

* Divine Legation.

LET-

LETTER XLIV.

ON so awful a subject as the appearance and general phænomena of nature, the mind of untutored man must long have been unenlightened. In the hurry of avocations for the necessities of life, little was the time he could apply to abstract speculations. The rising sun called him to his labour; and the brightest appearance of the starry heavens spoke no language to him, or only said, "Go weary labourer to rest." Many of more leisure, either had not an opportunity to interrogate nature, or wanted capacity to understand her answers.* The philosophical genius, whose sagacity, shaking off the yoke of custom, first gazed with admiration on the prodigies of nature which surrounded him, descended into himself, asked himself questions, and gave himself answers, concerning all the objects which he saw, must have been a long time in suspence, might even have died, without having credited his own opinions.

* Essay on Merit.

If we go back to the cradle of the human race, and in imagination venture a glance at their origin, we shall say, that man appears the result of general properties and energies: that male and female were born: that their existence has been coeval with the globe; and that so long as the globe shall last in its present form, they shall exist. But, in case the earth shall undergo a change, that then the human race shall undergo a revolution,— but, eventually be as well fitted to that change, as we are to what we enjoy at present. Every thing changes around us. We ourselves change. The face of nature is not precisely now what it was in former days; and further alterations probably will befall it in the progress of time. Suns have vanished from the sight of man; planets have seemed to perish, and disperse in the plains of air; other suns have been illumined; new planets have been observed to describe their orbits. And yet it cannot accord with the principles and analogies of nature, that existence, excepting in pairs, should have ceased; or that universal animation could have proceeded from solitary couples. At the same time, reason forbids, that man, a portion infinitely little of the globe; who is nothing but an imperceptible speck in immensity, that he

he should believe the universe made for him; that he is eternal; and in due succession, the sovereign of the world.

The great chain of causes, which links one thing to another, and extends even to the throne of God himself, can never be unravelled by any industry of ours. When we go but one step beyond the immediately sensible qualities of things, we get out of our depth. All we do afterwards, is but a faint struggle, that shews we are in an element which does not belong to us. But a free and impartial inquiry into truth, is far from being reprehensible. On the contrary, it is a disposition which every man ought in himself to labour after, and to the utmost of his power encourage in others. It is the great foundation of all our knowledge, of all true virtue, and of all sincere religion. * If in his researches, however, he should find his inquiries lead towards notions, which, if proved true, would subvert the happiness and the good of society; it would then be incumbent on him, as he owed it to virtue and to the dignity of a rational being, not to rejoice in the strength of his own arguments, nor applaud himself for the success of his abilities. To a good mind,

* Clarke.

this would be no gratification. To such a person, the finding, on the contrary, his own arguments unanswerable, would be the greatest grief; triumphing in so melancholy a field, would be the highest dissatisfaction; and nothing could afford so pleasing, or so agreeable a disappointment, as to find his own reasonings shewn to be inconclusive.

In what I have said, therefore, relative to the sacred books of Moses, it will not, I hope, appear, that I have turned a libertine or a wanton hand against the law, or the behest of Providence. Such an imputation, I trust I do not deserve. The idle and indecent application of sentences taken from Scripture, is a mode of merriment which a good man dreads for its prophaneness; and a witty man disdains for its easiness and vulgarity. But as it would be atheism to say there was no God; and equally so, to deny his providence; to restrain it to some particulars, and to exclude it in reference to others; so would it be a dereliction from the simplest deductions of nature, as well as an heresy from the opinions of the most enlightened fathers of Christianity, to refuse an assent to the figurative interpretation of the earlier parts of the Jewish story.

From

From the mystical account given us by Moses, of the creation of Paradise,, and of our First Parents, it will not be a violent transition to pass to that awful catastrophe which befell the earth —its general submersion. At the period of this almost universal destruction, it appears that seven persons only were necessary to deliver the history of the creation and fall from Adam to Moses; one man, Methuselah, having conversed both with Adam and with Noah, who was the ninth from Adam. Their ages, it is true, are recorded, as greatly to have exceeded ours. And if the genealogical descent be genuine, it must have been so. And indeed, it is almost incredible how few the generations have been, which have passed away, even between us and Adam. Between Adam and our Saviour, according to the genealogy of Saint Luke, the names, of both exclusive, are but seventy-four. From the birth of Christ to the commencement of this century, let it in round numbers be supposed, that in the list of any man's progenitors, every son had been born when his father was 25 years old, which is as early as can be supposed.* According to this supposition, there have been about four generations in every hundred years. In 1700 years

* Law.

consequently about 68 generations, which added to 74, would make no more than 142.

However this may be, deluges and earthquakes, says Bacon, open frightful abysses, which swallow up for ever the monuments and histories of nations. The ravages of plague; the destructions of war; all such particular scourges, come not in the least into comparison with these vast desolations, which leave nothing but a name, and a few wretched ruins imprisoned in the wreck of the devastation. All perishes almost then, even to the memory of anterior ages; the communication with those which follow, being broken by those violent shocks of nature. But most nations have a traditionary relation of a deluge; and whatever may be their estimated ages, they none of them pretend to go farther back than to a deluge. That calamity, they all suppose to have been prior to them. From that epoch, in a word, they reckon the renovation of the earth; of its inhabitants; of all moral and religious institutions; and of all sciences and arts. The traces of a deluge, or of deluges, are every where evident.*

Gibraltar

* D'Hankerville.

Gibraltar is situated on a high spacious rock. On the summit have been found masses of bones, forming as it were one substance with the rock: the matter of which the rock is composed, must consequently have been brought thither, after the bones had been deposited. Blocks of this rock are to be seen in the British Museum. Among these bones are to be found those of the human species, of both sexes, and of all ages. But it is singular, that amidst this wonderful aggregation of bones, those of men, as well as of wild and domestic animals, confusedly thrown together, not one vestige of aquatic animals has been discovered. This is a remarkable phænomenon; and being contradictory to what is generally observed of the fossils of the two kingdoms, is not easily accounted for. But Gibraltar is not the only spot where these wrecks of animals have been discovered. Yet Gibraltar is sufficient for our purpose at the present. It shews us, that the enormous space now filled by the Mediterranean and Adriatic seas, was once probably, inhabited by such men and animals as we find in Europe and in Africa. That they too had their cities, legislators, poets and orators. But what is become of these unfortunate people? Are these the only vestiges remaining of their existence?

The

The farther we penetrate into antiquity, the stronger are the symptoms of the belief of a deluge. The remembrance of such a disaster entered into the plan of all religions. The striking similitude between the ideas of the Scandinavians and Chaldeans, on the origin, and the end of the world; the traditions found in America, amongst the inhabitants of Florida and the Brasils, which are the same with those of the Japanese; prove, that the same misfortunes have befallen those countries, so widely asunder. All the plains of Syria, says Melo, were formerly laid under water. Plutarch, Ovid, and other mythologists, describe the deluge of Deucalion, which happened, they say, in Thessaly about 700 years after our epoch of the universal deluge. It is said, there was one in Attica 230 years before that of Deucalion. In the year of Christ 1095, a deluge in Syria drowned a prodigious number of people. In 1164, a deluge in Friezeland covered the whole coasts, and destroyed the greatest part of the inhabitants. And again, another inundation happened in the same countries in 1218, in which upwards of 100,000 men are said to have lost their lives. But the fate of Callao, as it has been one of the most recent, has been the most accurately described to us. Lima continued in great splen-

dor

dor until the year 1747, when a most dreadful concussion of the earth happened, which entirely devoured Callao, and the Port belonging to it; and laid three fourths of the city level with the ground. Nothing can be conceived, more terrible than the destruction of Callao. Of all the inhabitants, one man, and one man only, escaped. The people ran from their houses in the utmost terror and confusion. The struggling wretch who survived, heard a cry of *miserere* rise from all parts of the City. But all was immediately hushed. The sea rushed in and overwhelmed it. The inhabitants were buried in its bosom. All was silent as the grave.

It has been remarked, that some species of disputants, as some species of combatants, though possessed of no great valour, will yet fight excellently behind a wall: thus a man of tenacity, and strongly prejudiced, will be both fierce and rugged behind a text of scripture; but, in the open fields of reason and of philosophy, he will be gentle and tractable as a lamb. This is a position, uncontrovertible in some points, but in others, I should suppose much to be doubted. In Genesis, the account given us by Moses of the deluge, is short and plain.

He

He says, "All the fountains of the great deep "were broken up; and the windows and flood "gates of heaven were opened: and the rain "was upon the earth, forty days and forty "nights." These were the two grand sources of the deluge. Yet, one of these sources has been supposed more than sufficient for the purpose. Philosophers, say the advocates of this opinion, are puzzled to find water enough for an universal deluge. To assist their endeavours it has been remarked, that were all the water precipitated which is dissolved in the air, it might probably be sufficient to cover the surface of the whole earth, to the depth of about 30 feet. But this is physically erroneous; for should all the water in the atmosphere be in a moment condensed, it would be very far from being able to cause a general deluge. The calculation is to be made.* While suspended in the atmosphere, we must look upon the water to be rarefied. The atmosphere itself, weighs only a column of water from 32 to 33 feet. Thus, supposing it all water, it could not furnish more than this quantity. Allowing, therefore, the whole atmosphere to be water, and that it should have betaken itself to the lowest situation,—to the sea; and allowing also

* De Luc.

also the sea to be a moiety of the globe; the whole of these waters thus collected together, would not elevate the general level of the ocean more than 66 feet. How inadequate this to an universal deluge!

But there is a prodigious annulus encompassing Saturn; and why might not there have been one round our earth, for ab esse ad posse certissime valet consequentia? Why may it not likewise be supposed, that the vapours of the earth fermenting into inflammation, and expanding by rarefaction at the grand period of the deluge; by their elastic pressure on the subterraneous waters, should have forced those waters upon the surface? The surrounding ring, attracted by the nearer approach of the waters of the abyss, would of course have instantly poured down with waters of the atmosphere, and thus the cataracts and windows of heaven would have been opened. In the mean time, the earth would have shook and trembled. Subterraneous eructations would have distorted her strata in all directions; would have exchanged surface for core; and mountains for vallies. Earthquakes, volcanos, and convulsions, would have universally taken place, and, in short, thus the ruin would have been completed.

pleted. The two brothers *Sheutzers* again conceived the matter differently. They dissented from all complicated action;—they imagined that the motion of the earth, on its axis, was suddenly stopped by the supreme will; and that the waters, from the continuation of the force of their movement, at once spread themselves with violence over the earth: and by this, they persuaded themselves, they had explained all the phænomena of the deluge; even how the oriental plant was transported, and could find its way into Saxony.

If the universality of the deluge be insisted on, I will acknowledge, that unless we allow a creation and annihilation of waters; or the bringing down vast quantities from something which no longer exists, and which must have again been caught up by some no longer existing, subsequent attraction, no such universal deluge could have happened to this globe; nor could the face of nature have been restored to the state it appears to us at present, without having altered the whole terraqueous frame; and without having miraculously turned fluids into solids at once. The waters began to decrease after one hundred and fifty days. If the sea lie in an equal convexity with the land, or lower

generally

generally than the shore, and much lower than the midland, as it is certainly known to do, what could, on the other hand, the sea have contributed to the deluge? It would have kept its place as it does now. The same would have happened to the subterraneous waters, for water does not ascend unless by force. But, let us imagine force used, and the waters of the sea and caverns drawn upon the surface of the earth, we shall not be in any respect the nearer for this; for if you take these waters out of their places, those places must have been filled up again with waters during the deluge. You cannot suppose the channel of the sea would stand gaping without water, when all the earth was overflowed, and the tops of the mountains were covered.* The same may be said with respect to subterraneous cavities: if you suppose the water to have been pumped from them, you must likewise suppose the water to have been sucked back, when the earth came to be effectually laid under water. Thus, every way considered, we can neither find source, nor issue, for such an excessive mass of waters, as the general deluge would have required.

* Burnet.

We have already remarked, that the Israelites looked upon the earth as a vast plain, and that the rain came from a collection of waters above the firmament; at the same time that the earth floated on another mass of waters, both of which were opened at the deluge. "And God made the firmament, and divided the waters which were under the firmament, from the waters which were above the firmament." But, as such waters now are universally understood not to exist, and as the earth is mathematically ascertained to be a spheroid, the effects, or the conclusions drawn from data so erroneous, should cease with their causes. The belief, that the flood of Noah was not universal, (I mean universal as to our present earth) would likewise serve to solve several difficulties in the Mosaic history, in regard to the origin of nations, and to the inhabitants of the world after the flood; for, from the Mosaic account itself it appears, that Egypt was, in Abraham's days, a great, a civilized, a populous, and a luxurious kingdom, about three hundred and fifty years after the deluge; when it may be presumed there were not two millions of Noah's race upon the face of the earth. To this we may add what Moses relates of the cities Nimrod built, and the empire he raised, within a short time after the deluge; when there could not have been, according

cording to the Mosaic account of the numbers born to the children of Noah, five hundred of his descendants upon earth.

But, numerous passages of Scripture might lead us to suppose, that even Moses, in his account of this disaster, did not mean it should be considered as an universal one. The words *every*, *all*, *whole*, in many places both in the Old and New Testament, were only intended to be expressive of a great part, or a large number. Hence the flood, though said to be over all, may be supposed to have been over only a part of the earth. The introduction of hills and mountains, is only to add dignity and magnificence to the subject. Thus, one of the Prophets, commemorating the miraculous providence of God, in conducting the Israelites to Canaan, says, "The everlasting mountains were scattered, the perpetual hills did bow." Moreover, as Moses, after the eastern manner, and to confer eminent dignity, calls Judea, and the adjacent countries, the whole earth; why may it not be very consistently supposed, that by the submersion of the whole earth, and the extinction of the greatest part of its inhabitants, he meant nothing further than some fatal catastrophe of that nature, to the Jews, and to their possessions?

The Mosaic account, it is true, seems to express in general, that every part of the earth was covered with the waters; and that all flesh, in whom was the breath of life, died from the face of the earth, excepting Noah and those preserved in the ark. But several texts, though expressed in the same general terms, are necessarily restrained in their signification. The whole earth, the heavens, and such like expressions, signifying no more than the region of Judea, sometimes the flat country in Asia adjoining to it, or the atmosphere that lies over those countries. Even, in the Acts of the Apostles, it is said, "there were dwelling in Jerusalem, Jews, devout men out of *every nation under heaven.*" But, it was the universal practice of the Hebrews to express themselves in an elevated and a devout language, and to attribute almost all natural actions to God. Thus, if their industry brought them wealth, they would say, the advantage was derived to them from God. Had they a good thought, it was God that put it into their hearts. So in many instances, things were said to be divine, or to come from God, which were wonderful or extravagant, but which were still natural. "The mountains of God," was only another name for great mountains; "the sleep of God," for a deep sleep; and "men of God," for men

adorned with eloquence, piety, and persuasion. And hence, when in the Scriptures, the Prophets are said to have the spirit of God, the meaning is merely that they had great minds or spirits, or extraordinary holy dispositions. The expression, indeed, in the Hebrew, signifies no more, than what the Greeks mean when they say, talking of a poet or of an orator, that he has in his words something θειοτης, divine and admirable.

But, as I have already remarked, (and it is that which has injured not only the Scriptures, but impeached the veracity of the venerable characters who are mentioned in them) the representations of Moses and the Prophets were at times so figurative, and I hope I may be forgiven, if I say, so terrestrially gross, that they were accused of being Anthropomorphites; delineating the Almighty as they did with hands, with eyes, and with feet. The truth, however, was, and so it is in the Jewish belief to this hour, that the Israelitish rulers taught, God to be a spirit that beholds all things, is present every where, and that he acts as a spirit, and not as man. Such scriptural expressions, therefore, can only be admitted metaphorically, and as spoken ανθρωποπαθως, after the manner that men speak. Imposed by

authority, and assisted by illusion, the literal interpretation, indeed, of the Old Testament was long forced upon the conviction of ignorance and superstition. But the phrenzy of such enthusiasm, or the artifice of less pardonable pretensions, is now passed away. The Laity, as well as the Clergy, now search, reason, and investigate. Nor should the pursuit of truth be discouraged in apprehension of its consequences. Many men there are, neither profligate in their manners, nor commonly surpassed in talents, who yet have not the same veneration for the literal expressions of Moses that others have.* Truth can only subvert systems of superstition. The truly religious man must confess, that the faith grounded on reason, is that alone, which can be acceptable to God.

The writers of the books of the Old Testament, it is pretty evident, never intended to give an exact system of chronology, a thread of universal history, nor even a body of materials from which either might be compiled. The general contents of these books are extracts of genealogies, not genealogies; extracts of histories, not histories. The whole history of the earth is

* Bishop Watson.

is contained in the eleven short chapters of Genesis, and a more compendious extract was certainly never made. The design of Moses, as I have already remarked, was merely to inform the people of Israel, of their descent from Noah by Sem; of Noah's from Adam by Seth; to illustrate their original; and to establish their claim to the land of Canaan. But, our habits of thinking so fondly connect the order of the universe with the fate of man, that it in general is more pleasing to rest even upon images, metaphors, and incomprehensible extravagancies, than to have the mind freed from the influence of poetic fascination in matters of religion. I do not presume to accuse all believers of prejudice. I would not, for I do not, mean to give offence. Moreover, every allowance is to be made for those modes of reflection, the efficacy of which, in giving a particular bent to the understandings of men, we can neither investigate, nor comprehend. But, there are undoubtedly those, who pretend to the exclusive possession of knowledge, and who insist upon every thing, because they are unwilling to appear ignorant. When the way of reason, therefore, fails them, they turn to authority. Behind an implicit credance on this, they endeavour to screen themselves, and to preserve their reputation. They, in short, would make us all to be

of the same complexion of mind, as we should be of the same colour, were we plunged into one common night. Liberality cannot therefore be too strongly recommended in discussions of this nature; nor can a better lesson be given than in the words of bishop Watson. "I think it just as illiberal in divines, to attribute the scepticism of every Deist to wilful infidelity, as it is in Deists to refer the faith of every divine to professional bias."

The Sacred Writ, it is said, is no where contradicted; but, on the contrary, is really confirmed by the natural and civil history of the world, collected from common historians, from the state of the earth, and from the late invention of the arts and sciences. * "From the creation to the captivity, for between three and four thousand years, it contains an unbroken thread of common and civil history. There may, indeed, be mistakes of transcribers, there may be other real or seeming mistakes, not so easily to be accounted for; but, there are certainly no more things of this kind in the Scripture, than what were to have been expected in books of such antiquity; and nothing in any wise sufficient to discredit the general narration." I will confess, the world

* Bishop Butler's Analogy.

world was never, perhaps, better qualified to judge and to decide on the authority of historical monuments, than at present. Of the nations of the earth, it is probable, there is not one now entirely unknown to us. And, although there should be in the interior parts of Africa, or in the remotest regions of America, some obscure and hitherto undiscovered nations, yet we may safely venture, I think, to affirm, they could not inform us of any thing more certain or more authentic in matters of antiquity, than we can learn from the Israelites, the Hindoos, the Chinese, the Arabians, and the Egyptians.

The tradition of the manner how, and the time when, creation took place, seems to rise out of the abyss of time, with the impetuosity of a great source. But, it has not taken a course conformable to the ordinary currency of things, which, strong in the beginning, glides silent and gently on, in proportion to its extent, till at length it becomes weak, and imperceptibly loses itself in the ocean of oblivion. Our world, and the whole solar system, and it cannot be too often repeated, undoubtedly began in time. But, an unwise advantage is given to Atheists, by the manner in which the tradition of this commencement is employed. Would it not be

sufficient

sufficient, were we to content ourselves with knowing what God has done, and for that reason, acknowledging that such must have been wise and good, and fit and right to be done? But, this will not content us. It is not enough for us to know that God made the world, and to fix the time when it was made; we must, in ostentation, venture even still farther, and endeavour to explain the motives that determined the Supreme Being to create the world, and the inhabitants which he has placed on it. But, let us ask a candid mind, if it be not repugnant to all the ideas we ought to have of the Divinity, to pretend that the day of rest, which Moses supposes God to have taken, and which the Jews invented, to make one of their institutions more respectable, was literally a day of rest from fatigue and labour to the Father of the world? Or that six days creation, that is, six times our twenty-four hours, and that too before the course of the sun to measure days could be observed, before even the sun, according to the Mosaic account, was created, should be taken in the common acceptation of the words given us in Genesis? Limited periods cannot, with propriety, I conceive, be ascribed to the Almighty Creator of the universe; nor should hours be prescribed to him,

to

to whom ages are but moments, in the duration of eternity.

But, on the unpresuming grounds of analogy, and here we strike into a new road, may not the allegorical language of Moses be in some degree interpreted, so as to satisfy common understandings? The same misfortunes have every where inspired the same sentiments. The same events have furnished the same ideas and the same images. Adam, it is certain, might have been created, as is mentioned in Scripture, or he might have been simply the founder or first parent of a nation; that is, their legislator, or the reformer of their manners, their religious institutions, and their ceremonies. But, to me, there appears somewhat more in the words of Moses; and I am consequently very much inclined to believe, that the period which, according to the Old Testament, commenced with Adam, might be founded on similar causes with that of the post-diluvian world, beginning with Noah. Both I would suppose to have been saved from destruction, by the all-protecting hand of Providence; and as the latter became the head, as it is believed, of the present race of men, so might the former, as an original and an enlightened stock, have been handed down to us

as the general parent, and the first created of human beings. In venturing upon this unusual kind of interpretation, my mind is witness to the purity of my intentions. It is not in the vanity of a new hypothesis, that I would venture upon such a subject. I search after truth with a thorough impartiality, and I would, at least to my own conviction, reconcile the Jewish story to plain sense, and to those unsophisticated conclusions, which are alone capable of the dispersion of doubts concerning things beyond the reach of natural observation. In the most pious minds, indeed, it must be allowed, there may be a latent and even an involuntary scepticism. The admission of supernatural truths, is much less an active consent, than a cold and passive acquiescence. * Accustomed to observe and to respect the invariable order of nature, our reason, or at least our imagination, is not always sufficiently prepared to sustain the idea of the visible action of the Deity in creation.

A great man † long ago remarked, that he found every sect, as far as reason could help them, make use of reason gladly; but, where reason failed them, crying out, it was matter of faith, and above reason. The limit between faith,

* Gibbon. † Locke.

faith and reason should be more accurately fixed. There are some sorts of tradition, which, as they contract the rust of antiquity, grow more to be respected. The fact, that was delivered at first on very suspicious testimony, becomes indisputable; and the opinion, that was scarcely problematical, becomes a demonstrated proposition. Nor is this at all wonderful. We look at original through intermediate authority, and it appears greater and better than it really is, just as objects of sight are sometimes magnified by an hazy medium.* Adam and Eve, I must be pardoned therefore in believing, to have been the wrecks of an ancient people; and the six days work of the creation, as a six days struggle among the distresses of a deluge, or some such dreadful calamity; and from which Adam and his partner were providentially rescued. "The earth was without form, darkness was upon the face of the deep, and the Spirit of God moved upon the face of the waters." All this, to me, is clear and intelligible. It points, in sublime and figurative language, to a desolation of waters. From peaceful habitations, and from a country, perhaps, cultivated and flourishing, these remnants of an annihilated race might have been driven upon less hospitable shores. Expulsion, therefore,

* Bolingbroke.

therefore, and in oriental figure, from a *Paradise*, might have been the fact. But such expulsion seems to have been occasioned by submersion, and not by the unpardonable offence of eating a forbidden fruit. The hand of the Divinity is always, I will confess, supposed to be stretched forth, in the punishment of the transgressions of mankind. But, without going so far, when wretched survivors from a disastrous scene, roam about in misery and in want, chastisement may readily be believed to have been intended, by the infliction of such exemplary punishment, and they, even without figure, may be allowed to bemoan the paradise from which they had been driven.

Chaos, according to the opinions of the philosophers, poets, and priests of antiquity, was the most ancient of all beings, the eternal being, the first principle and the cradle of the universe. The Scythians, Persians, Egyptians, the Greeks, and the Romans, agreed in this doctrine, and conceived the successive periods and revolutions of this chaos to have continued according to the laws of motion, till by different combinations it at last formed the universe, in that order in which we see it at present. To whom we ought to ascribe the origin of this notion, it is not

easy to say. Moses is looked upon by many as the most ancient of all writers; and so admitted, he is of course the first author on the subject of a chaos. But others deny that he is so to be considered. They adjudge the doctrine to the Scythians, and declare, that it was derived from them. Whether this can be proved, I will not pretend to determine. But it is insisted, that it is even doubtful, whether the Books of Moses were written by that legislator himself. Father Simon, an accurate investigator, will have it, that they, as well as all the other more ancient parts of the Bible, were written by some Jewish Scribes, who had compiled the memoirs of that nation; and that they were formed into a whole, with additions and amendments, by more modern historians. Spinoza daringly supposes them to be a forgery altogether. However this may be, it seems extraordinary how Moses could, in every particular, have been the author of all that is given to him, unless he can be supposed to have written after his own death; for it is said, "Behold! the words which Moses *spoke* before all the children of Israel." "Moses *was* the meekest man upon the earth." "There *arose* not a prophet in Israel like unto Moses." The writer of the Pentateuch even gives an account of Moses's death

death and burial, in the last chapter of Deuteronomy.

The collecting of the Sacred Writings is unanimously ascribed by both Jews and Christians to Ezra. But some of the ancient fathers, on the foundation of the Second Book of Esdras, believed, that the Scriptures were entirely lost in the Babylonish captivity; and that Ezra had restored them again by divine revelation. In the reign of Josiah, indeed, it is acknowledged there were no other books of the law extant, besides those found in the Temple by Hilkiah. Nor was it till after the return of the Jews from the Babylonish captivity, that Ezra got together as many copies as he could of the Sacred Writings, and out of them, prepared and published a correct edition. But inspiration from the Divinity must not be too lavishly ascribed. Moreover, there are not a few who suppose, that the Pentateuch, as well as the greatest part of the Old Testament, was invented by Esdras, and by him promulgated as the genuine text of Moses. Here, however, we must be guarded. In giving implicit confidence to even the greatest names there is danger. The undue weight of what are called *great authorities*, always curbs the spirit of enquiry.

quiry. Absurdities often obtain currency from authors, who do not think for themselves, but, who gain a fashionable and temporary reputation, by dealing out phantoms which they have borrowed, and by repeating them, till they are believed.

On such a subject as that on which we are engaged, which encourages the freedom of enquiry, but submits only to the force of probable truth, it would be extravagant, to suppose it possible for one man to imagine and promulgate the vast variety which is contained in the Old Testament. What toil in the composition of such a series of history! What labour to make the parts tolerably hang together, and so as that they should not be doubted by the Jews themselves! Again, how many stiles were to be displayed; the forcible and sublime expressions of Job, Isaiah, and several of the Psalms; the majesty of Moses, the plaintiveness of Jeremiah, the closeness of Solomon, and the enigmatical visions of Ezekiel and Daniel! This, it must be confessed, was too much for any one man. To give it to Esdras, therefore, is little less preposterous, than it would be to give all the poems and histories of the Greeks and Latins to Thucydides or Livy. But Latitudenarians sneer at the stile of the Scrip-

tures. Are they wise in so doing? Are the Greek and Latin classics the only standards for true eloquence? The persuasive power of words is not confined to any arbitrary limit. It rests upon the local opinions and customs of men, so that the eloquence of this nation, or of that age, may be looked upon as barbarous in another. The Greeks and Latins, I will allow, are the standards of eloquence to those who have enriched themselves from their valuable sources. But between these and the easterns there is no analogy to be drawn. Moses and Isaiah wrote agreeably to the purest eloquence of their own days. But their language was not measured by Quintilian's Institutes; nor was their oratory founded on Aristotle's rhetoric. The faculty of persuasion, in short, is that which is looked for in all true eloquence; and on this ground, the holy writings may lay at least as fair a claim to it, as any of the compositions of the ancients.

The doctrine of a chaos was not peculiar to Moses; all nations, barbarous or civilized, seem to have preserved one common tradition of a state of darkness and confusion, prior to the creation of the world; and it is probable, they all derived it from one common source. For instance, what can be more striking than the correspondence

respondence between Moses's account of the creation, and the poetical deduction from chaos, as given us by Ovid? That the original state of the universe, previous to creation, was an heterogenous mass, is readily to be believed, for parts must have existed prior to their cohesion; and they must have extended, before extensions were united. But, the ideas which the Hindoos entertain of God, of Angels, of the Word, of the Spirit, of Paradise situated towards the source of the Ganges, of the Garden of Delights, in which was a tree, the taste of the forbidden fruit of which was to give immortality, and of various other matters mentioned in the *Vedams*, would lead one to trace a prodigious resemblance, if not an actual sameness between them and the text of Moses. But, that which is more strange, Brouma is said to have communicated these doctrines to the Hindoos, at least two thousand years before Moses could have received them from the family of Shem, from whom he was descended. * Might not Moses have dipped, therefore, in the same source with the authors of the Shaasta?

Men, in their early researches among the objects of nature, for those by which they may symbolically represent their ideas of a Divinity, generally seem

* D'Hankerville,

to have fallen upon the same figures. *Fire*, whose action is apparently essential to the generation of all things, without which we could not exist, but whose agency likewise most suddenly occasions destruction, has been the first emblem of the *first principle*, and has been consequently represented under that *pyramidal* form, which flame always assumes. The sun, again, or the effulgence of light which proceeds from that all-vivifying luminary, and which has been supposed the secondary or *generating principle*, has been given under the *oboliscal* form. But the birth of things, the universal burst of existence, has been depicted under the emblem of the *Tamara* plant, one of the tribe of Nymphæa, which, during the darkness spread over the abyss of chaos, has been supposed transported on the surface of the water, and in contact with fire, to have been incubated on the body of that element.

Now, to this day, the Hindoos place their Brouma on the Tamara; and we know, the Egyptians seated their Isis, as well as others of their divinities, on the Lotus, which is also of the tribe of Nymphæa. * Chaos, then we see, was universally looked upon as the womb of nature, and not her grave. And hence we may interpret

* D'Hankerville.

pret it as a metaphor, and similar to what we meet in the poetical language of one of the Prophets, "the Almighty Architect as measuring the waters in the hollow of his hand; meeting out the heavens with his span; comprehending the dust of the earth in a measure; weighing the mountains in scales, and the hills in a balance."

Among the first of the striking phænomena of nature, human intelligence and reason are, perhaps, the most wonderful. But these even, like the inert masses of matter, have been seen to arise from the principle of generation, and from no other principle. The world, therefore, at large, whence these have been derived, has been supposed a created being, and to have had its origin from a chaos. Hence Hesiod, and all the ancient mythologists, universally explained the origin of nature, from an animal birth. The theology of the ancients is every where pervaded by the same ideas. Thus we learn, that the center of all power, of all intelligence, of all perfection, God, existed before all things, before all animated beings, before even time itself. Invisible by his essence, his invisibility was the primeval night which preceded time and light. During that night, his power produced what had

been conceived by his intelligence; and therefore, it was why night was called the mother, the generatrix of all things, Νὺξ γένεσις πάντων.* In an immense egg, God enclosed the germs and principles of all things. From that egg a being proceeded endued with both sexes. It was the first production, and served to separate the confused elements of the chaos, and to develope the germs of animated creatures. The divine power, or virtue, thus committed to a Son, sufficed for the creation of the material world; but, to vivify the germs, it was necessary to *breathe a spirit* which should animate them. This spirit was called *Love*. Orpheus gives him the appellation of πνεύμα, and of παντογένεθλα: and according to Hesiod, he was contemporary with chaos. Ἤτοι μεν πρωτιστα Χαος γένετ' αὐτὰρ ἔπειτα.— Ἠδ' Ἔρος. † At the time that the world issued forth, there existed none other but God, his power or supreme virtue, and his wisdom or his spirit. From these two metaphysical beings personified, proceeded, the Son, or divine energy and love; and by them were all creatures generated, and afterwards preserved.

Orpheus,

* Orph. Hym. 2. † Theog. v. 116.

Orpheus, from whom Homer borrowed much of his eastern learning, was the first who introduced the doctrine of the mundane egg among the Greeks; and he is generally supposed to have borrowed it from the Egyptians, who represented the world by that symbol, as many other nations did, such as the Chaldeans, Persians, Phœnicians, and Chinese. * The two essentials in the composition of all sublunary things were, by the ancient Greeks, termed *psyche* and *hyle*, that is, spiritus et materia, soul and body. Both these they held, as taken in their single natures, to have been from eternity, and to continue to eternity, and which, united into one infinite, they held to be God, the maker of the world. But, from this opinion an absurdity arose. In the vanity of his own perfections, man supposed himself to be in consequence a microcosm; for he was as a supreme upon earth, and he was composed of the psyche and hyle. The words of Moses, however, wherein he says, "that in the beginning of the creation the spirit of God moved upon the waters," have a strong affinity to the theological tradition of the Heathens, and refer us at least to one common fountain head, for the origin of the belief. The books of Moses preceded

* Univer. Hist.

the doctrinal poetry of the Greeks. But there is a strong similarity between the Hebrew and the Scythiac languages, and what is still more worthy of consideration, the first religious principles of both seem to have turned upon the same points.

It is not very readily to be credited, but however unaccountable it may seem, the worship of the *serpent* has almost universally prevailed. * Even in the orgies of Bacchus, the persons who partook of the ceremony, were obliged to carry serpents in their hands, and with horrid screams to call upon *Eva, Eva.* Epiphanius thinks the exclamation related to the mother of mankind, who was deceived by the serpent. But such a propensity to this particular mode of worship, such a mysterious attachment to the serpent, as is found to have been among the ancients, is wonderful: can it be believed, that it even obtained among Christians, and that one of the most early heresies of the church was of this sort? Tertullian says of this sect, "Accesserunt his hæretici etiam illi, quî ophitæ nuncupantur: nam serpentem magnificant in tantum, ut ullum etiam ipsi Christo præferant. Ipse enim, inquiunt, scientiæ nobis boni et mali originem dedit.

* Bryant's Mythol.

dit. Ipsum introducunt ad benedicenda Eucharistia sua." The first variation from the purer *zabaism* consisted in the *ophilatreia*, or worship of the serpent. The chief deity of the Gentile world was almost universally under this symbolical representation. The serpent among the Ammonites was stiled *Oph*, by the Greeks expressed Οφις, which term was continually combined with the different titles of the Divinity.

But if this be extraordinary, how much more so is that which is no less true, that the most dangerous reptile existing, should have been chosen by the ancients for the symbol of *life*, and twisted round the rod of Æsculapius; that it should have become the symbol of health, and of the divinity of medicine! Nay, we may go further, and on the heresy mentioned above by Tertullian, observe, that as mankind are said to have been ruined through the influence of this being, how strange is it that it should have been adopted as the most sacred and salutary symbol, and rendered a chief object of the adoration of mankind? But, here the writings of Moses will come again to our aid, and in them we shall find issued forth as the express command of God himself, that the serpent should be the symbol of life. "And the Lord said unto Moses, make thee a

fiery serpent, and set it on a pole: and it shall come to pass, that every one that is bitten, when he looketh upon it, shall live." And further, from the New Testament, we shall find the most solemn analogical application made of this symbol. "And Jesus said, as Moses lifted up the serpent in the wilderness, even so must the Son of Man be lifted up; that whosoever believeth in him shall have *eternal life*."

Whence are we, philosophically or historically, to derive this mystical emblem of existence? Or how are we to account for its general currency among mankind? And particularly, as it is to be traced in countries, the most distant from each other at this day? In ancient story, we scarcely meet with any thing but the serpent or dragon. The golden fleece was protected by a dragon, born of the monsters Typhon and Echidna. The Hesperian Garden was guarded by a dragon; nor was it possible to get at the forbidden fruit, without destroying this hissing centinel. Apollo is made to kill the python. Juno sends serpents against the infant Hercules. The companions of Cadmus are devoured by a serpent. A serpent is put into the hands of Saturn, to typify an annual period and its revolutions. Serpents are given to Mercury and Æsculapius. Hygeia, the

the goddess of health, is pourtrayed with one drinking from her hand. The Egyptians grouped the serpent with the sun and the moon, their Isis and Osiris, *their brother and sister, husband and wife*, as the symbol of eternity. I here, however, for a moment, must deviate a little from the very circumscribed limits to which we are confined by the Hebrew text. To divest the mind of partiality, and to give the full energy of its power to a calm and an unprejudiced research, are points which will at least ensure a rational and a guarded adherence to probability. Prudence, indeed, would probably enjoin us to steer clear of the materials to be drawn from the obscurity of such very dark ages, and to be content with the pursuit of the beaten track. But, if enquiry be not made, truth may for ever lie concealed; and I feel there is at least a pardonable degree of ambition, in aiming at the dispersion of the clouds of prejudice by which we have been surrounded. To the words of Moses I pay a sincere and an unaffected homage. I reverence his genius, and I am far from suspecting his veracity. He was indisputably a favoured man of God, and a great statesman. But, I see the interpretation of what he has handed down to us, in a less metaphysical light, than that in which it has been seen by others; and

and on such grounds, I feel that I am not to blame in endeavouring to establish at least the principles of my own belief.

The Scythians, we are informed by Herodotus, were, as the Israelites, remarkably attached to an emblematical method of expressing their ideas. They looked upon themselves as the most ancient people upon earth, and commenced their history by the fable of a virgin born of the earth, whose form, as far as to the waist, was that of a woman, but whose termination was that of a serpent. That this virgin, having had commerce with a God, became the mother of a son, named Σκυθας, which son becoming more illustrious than any other man, gave his name to the whole nation of the Scythians: and that this led the Scythians to believe their appropriate appellation, to be the eldest upon earth.* This mother of the Scythians was supposed to have inhabited a cavern. "Ibi in antro quamdam invenisse Mixoparthenen Echidnan Biformem." The name of Echidna, besides that of Mixoparthenen, was thus also given her, and it was said to have been derived from Εχις, which signifies a female viper, and is the same with Heva, or Eva, which signifies *life* or serpent. "Nomen Hevia aspiratum, exponitur

* Herodotus. Diodorus Siculus.

exponitur vipera fæmina." * Thus the word Echidna would seem to have been a literal translation, or at least an imitation of the word Heva. From this then we may in some degree explain the mystical sense, attached to the emblem of the serpent, as the symbol of life. It was founded on the analogy between the name given to the serpent, and the word which signified life, and it in every respect accords with the symbol of the life *present*, as given in the Old Testament, and of the life *eternal*, as promised in the Gospel.†

From what we have thus seen, the principles of the world were emblematically figured by the egg, because it contained life; and the spirit, divine energy, or intellectual world, by the serpent; but, we have still the symbolical representation of the Creator of the material world to look for; and that we shall likewise find among the Scythians, in their *Apis*. With the Scythians, *Tho*, or *Theo*, which signified literally this animal, was at first the symbol of the first principle, but he was afterwards ranked as the second, and was then considered as the generator only.‡ The attachment of the Israelites to this symbol was extreme,

* Clemen. Alex. † D'Hankerville. ‡ Ibid.

extreme, even after they were forbidden it by the positive commands of Moses. But, their predilection for the serpent was still more intense: nor was it until the days of Hezekiah, 726 years before Christ, that this abomination was torn from the land. "And Hezekiah removed the high places, and brake the images, and cut down the groves, and broke in pieces the brazen serpent that Moses had made; for unto those days, (that is 725 years after the death of Moses) the children of Israel did burn incense to it." In the Bible it is also forbidden to consult the Pythias, or serpents of the caves. The Pythia of Endor called up the shade of Samuel, and shewed it to Saul. And hence we see how close the affinity between the Israelites and the Scythians; how the symbolical worship of the one must have been derived from the other; particularly the emblem of that Providence which dealeth out life and death in the serpent; and how clearly we may in consequence deduce from the Scythiac superstition, the Hindoo, Egyptian, Greek, and Roman emblem of the *Lingum*, or Phallus; an emblem of the Creator, and not of obscenity, as hath been erroneously conjectured.

But,

But, we shall have occasion, by and by, more fully to display the eastern branchings from this Scythiac root, which have evidently intrinsic and striking family resemblances. One of the personified attributes of Veeshnoo, or the Deity, in his preserving quality, among the Hindoos, *Haree*, is represented as sleeping upon a great serpent. The Hindoos are taught to believe that at the end of every kalpa, or creation, all things are absorbed in the Deity; and that between the intervals of creation, he reposeth himself on the serpent *Sésha*, or duration, who is also called *Ananta*, or endless. They are likewise taught to believe, that organized matter is governed by three principles, which are termed *Satwa*, *Raja*, and *Tama*. The first inspires truth, the second passion, and the third sin. By their laws, also, they are enjoined to esteem fire as of divine origin. At certain periods it is prescribed, that they light a fire, which must be done by the friction of two pieces of a particular species of wood, and that this fire shall be kept up as long as they live. Their sacrifices, it is ordained, shall be all burnt by this fire; the flames of their nuptial altars be raised, and finally, their funeral piles be kindled by it. *Soorabhees* is the name of the cow of plenty, or more

more properly of the earth. But, Nature herself, from whom all things are made, is personified as a beautiful female, whom, we are told by a most learned oriental scholar,* is literally the *Eve* of the Hindoos.

That the worship of serpents was formerly common in Hindostan, we have many proofs. In Cashmere, there were no less than seven hundred places, where carved figures of snakes were worshipped. † In like manner, we are told, that in Egypt the serpent was adored as the emblem of the Divine Nature, not only on account of its supposed great vigour and strength, but of its extended age and revirescence; ‡ but more properly, perhaps, as it had an hieroglyphical connection with certain planetary orbits. Even the solar progress is depicted by the Hindoos, by a circle of intertwining serpents. The Chaldeans, Arabians, Chinese, and Persians, adopted also, in astronomy, the emblem of the serpent. And hence, says an eminent astronomer, § "the ancients, by the draco, or serpent, did not mean that fictitious and monstrous figure with wings, which we see represented in modern paintings,

* Wilkins. † Ayeen Akberry. ‡ Warburton.
§ Dr. Long.

paintings, but simply a large snake, by a comparison of which with the two points in the heavens, where the moon's apparent orbit cuts the ecliptic, and are called the moon's nodes, the figure is plainly to be traced of the progressive union of their astronomical speculations, with their hieroglyphical theology.

LETTER XLV.

THE task of clearing the mind from the delusions of error, independent of the courage which is required in laying aside authority in the search of truth, is difficult in itself, and not unfrequently dangerous. Men pertinaciously attached to certain professions, or hurried away in the pusuit of fame, or the more laudable desire of strengthening opinions which have been pre-established, are not, in general, the least irascible in their natures, nor the least confident in displaying their talents. This, indeed, ensures to them the reputation of profundity and learning; and it enables them, from the variety of their reading, and the popularity of their expressions, to throw forth that web of fascination, which never fails to entangle and to fix the admiration of the many. But yet, much reading will not lead us so soon to truth, as much observation and much employment of thought. From the one, it is certain, we in a great measure must draw our materials; but it is from the others we must acquire that habit of discrimination, and that strength

strength which arises from conviction, and which is alone adequate to the bursting of the involved and the complicated fetters of prejudice. In thus emancipating the mind from every unfair restraint, I am far from the idea of conceiving it even pardonable, that licentiousness should be tolerated and spread abroad with impunity. On the contrary, those writers of great talents, who have employed their rare abilities in the propagation of immorality, and who have with brilliancy of stile, with wit, but with wretchedly mistaken pleasantry, endeavoured to season vicious sentiments, and to allure the unsuspecting to those precipices, where the steadiest brains have been too often rendered giddy; such writers I cannot otherwise look upon, than as disturbers of society; and as enemies, though unintentionally, perhaps, of their country and of mankind. Nor is it during their own mere existence they are, in this manner, reprehensibly injurious. They leave behind them a dire contagion, similar to those who die of a pestilential disease, which eventually scatters an infection, that is baneful to posterity.

But, the fairly disposed philosopher, who has been accustomed to reason with a generous freedom, and to expatiate in the fields of science, is

not to be cramped by the limits which a sectarist would impose; nor to decline an investigation with the religious horror of a bigot. To emerge from the pale of a sect, is not incontinently to wander in the confines of impiety. On the subject, for instance, on which we are at present engaged, the diversity of even religious opinion is so great, it is not clear to me, but that a man might be adjudged deserving of persecution, who should venture to assert, that Moses had written literally, or that he had written figuratively. In how many different and inconsistent ways are the Scriptures explained? According to certain Doctors, there is a grammatical, an historical, an allegorical, an anagogetical or divine, and tropological or moral sense, in which they are to be taken. But, can the writings of any people, sacred or profane, be ever fixed, if they are to be subjected to such licentious interpretations? The records of antiquity, it is true, are not in all respects connected; nor are they so entirely clear of error, as to be freed altogether from suspicion. But, yet from what we can collect from Heathen as well as from Jewish writers, it is manifest that the history of the Hebrews was less celebrated, and even *less known*, than that of any other people, whose memory antiquity hath handed down to us. Is it not hard, then, that from an ill-directed zeal of

doing

doing honour to the Bible, no country is allowed to have been capable of producing even a single hero, but that all must be brought from the land of Palestine? On such preposterous ground, Moses, the law-giver, simply, of the nation of the Israelites, is discovered to be Apollo, Pan, Priapus, Cecrops, Minos, Orpheus, Amphion, Tiresias, Janus, Evander, Romulus, and about twenty more of the Pagan gods and demi-gods. *

In our foregoing disquisition we ventured upon the threshold of a Scythiac antediluvian hypothesis. But, as the materials for an elucidation of a period almost imperviously involved in darkness, are scanty, and necessarily conjectural, we shall, for the present, pass over the 1656 years which are reckoned to have intervened between the creation and the deluge; and bring ourselves at once to that, the most awful epoch in the annals of the world.

The tradition of a deluge is universal. "And God said unto Noah, the end of all flesh is come before me; for the earth is filled with violence; and behold, I will destroy them with the earth. And the flood was forty days upon the earth, and

* Divine Legation.

the waters increased, and bare up the ark, and it was lift upon the earth. Fifteen cubits upwards did the waters prevail, and the mountains were covered." * Of the waters having covered the globe, the Scythians had traditional accounts, and that their country was the resting place of man. The Hindoos, also, though they do not agree as to the age of the world, as given us in Scripture, have their account of a general submersion; nor is what they report very dissimilar to that which we collect from the Books of Moses. "Sattiavarti, informed by Veeshnoo, that there would shortly be an universal deluge, betook himself to a mountain. The waters of the heaven and of the earth soon after gathered together, and rose till they covered the tops of the highest mountains. In this disaster all animated beings were destroyed, excepting Sattiavarti; who, with a few companions, entered into a vessel which presented itself to them. In this vessel eight hundred and forty millions of souls, and the germs of beings, were placed by Veeshnoo. God, in the shape of a fish, guided the vessel; and Sattiavarti and his companions continued in it, until the waters had subsided. Veeshnoo is given ten descents in a human form, and these are called the ten Avatars, agreeing in every

* Genesis.

every respect with the ten Sari of the Chaldeans, and the ten Sephiroth of the Hebrews. The first incarnation of Veeshnoo, or the Matse Avatar, represents him as composed of man and fish; as Oannes, or the fish-god of the Babylonians; and Dagon, or the fish-god of the Phœnicians. We have likewise, in the Courma Avatar, Veeshnoo's descent in the form of a tortoise, to support the earth sinking in the ocean; and the mountain Mandar, round which the serpent Asookee is represented as twined in dreadful folds. The Soors and Asoors, then, with their utmost might pull Asookee by the head and tail. From his mouth issues a continual stream of fire, which ascending in thick clouds, replete with lightning, it begins to rain. In the mean time, the ocean is violently agitated, and roars. The conflagation and ruin spreads wide on the face of the earth; and even every specific being of the deep, and all the inhabitants of the great abyss which is below the earth, are annihilated.* "In a word," says Sir W. Jones, "the three first Avatars apparently relate to some stupendous convulsion of our globe, from the fountains of the deep"†

And what is more, we read that, deprived of the vigilant care of Brama, the world fell into

 disorder;

* Geeta. † Asiatic Researches.

disorder; that the human race became in every respect corrupt; and that in consequence, they were all destroyed in a vast deluge, except a certain pious king and his family, which (in extraordinary conformity with our holy writ) is said to have consisted of seven persons, who floated upon the waters in a vessel fabricated by the express direction of Veeshnoo. After a certain time, the waters abated, and the king and his family descended on dry land. *

The Egyptians, likewise, had striking memorials of the deluge. In their ancient mythology they had precisely eight gods; of these, the sun was the first, and the first that was supposed to have reigned. "But these were no others," says Bryant, "than Noah and his family." Time and all things, it is said, were by the ancients deduced from the patriarch. Hence they came at last, through mistaken reverence, to think him the real Creator, the δημιουργος, and that he contrived every thing in his chaotic cavern. † All the mysteries, indeed, of the Gentile world are supposed to have been memorials of the deluge, and of the events which immediately succeeded it. They consisted, for the most part, of a melancholy process; and were celebrated by night

* Bhagavat. † Bryant.

night with torches, in commemoration of the darkness, in which the patriarch and his family had been involved. "After the oath had been tendered to the Mustæ, we commemorated the sad necessity by which the earth was reduced to its chaotic state. We then celebrated Cronus, through whom the world, after a term of darkness, enjoyed again αιθερα, the serene sky."

"The first great event in the history of time," says Berosus, "was the appearance of Oannes, the man of the sea. This person is represented as a preacher of justice, and a general instructor and benefactor. He informed mankind of what had passed in preceding periods; and even more, he went as high as to the chaotic state of things before the æra of creation. He taught, that there originally was one vast abyss, which was inveloped in universal darkness. This abyss was inhabited by myriads of miscreated beings, who were most horrible. To these succeeded a set of rational beings, who partook of divine knowledge; but who, not being able to bear the brightness of new created light, perished. Upon this, another set of rational beings were formed, who were able to bear the light. The Deity also formed the stars, together with the sun, moon, and five planets. He then gave an account

count of the wickedness of men, and the ruin of all mankind by a deluge, excepting Sisuthrus." Now, Oannes and Sisuthrus held the same place in the real history of the Babylonians. And that Sisuthrus may be Noah, is not difficult to be believed. From all this we may gather, therefore, that the account given us by Moses is true. And though nations, who preserved memorials of the deluge, did not, perhaps, state accurately the time of that event; yet it will be found that the grand epocha, to which they referred, was the highest point to which they could ascend: and further, that whatever titles may be given, that Noah was the first king in every country.* "That this is running counter to the opinions of all antiquity," continues Bryant, I am well aware, as it is to the opinions of the Fathers, and of other learned men, who have supposed the first kings or gods of the Heathens to have been deified mortals. The Greeks had Θεοι Αθανατοι, and the Romans their *Dii Immortales*; and yet acknowledged they were but men. Maximus Tyrius, the Platonist, could not but smile at being shewn in the same place ἱερον Θεω, και ταφον Θεω. "To me, however," continues Bryant, "it is plain, that the Grecian deities were not the persons supposed; that

* Bryant.

that their imputed names were titles; and that they all alluded to the same story. Nor can I acquiesce in the stale legends of Deucalion of Thessaly, of Inachus of Argos, and Ægialeus of Sicyon. The supposed heroes of every age, in every country, are fabulous. No such conquests were ever atchieved, as are ascribed to Osiris, Dionusus, and Sesostris. The histories of Hercules, and of Perseus, are equally void of truth, Ninus and Semiramis were personages as ideal as the former. I make as little account of the histories of Saturn, Janus, Pelops, Atlas, Dardanus, Minos of Crete, and Zoroaster of Bactria."

This unqualified and unmerciful sweep of all the remarkable personages of antiquity, is, I must honestly confess, too much in my mind for even scepticism itself. Tradition, it is true, furnishes very precarious anecdotes to us, at so great a distance of time. It is undoubtedly difficult, perhaps impossible, to ascertain, to a demonstration, the facts, or the dates of the facts, which have been given to us. Neither is it very practicable to say, which should be rejected, or which should be received. But, that all should succumb to one, is, in my way of thinking, neither reasonable nor just.

By

By faith I might, indeed, be brought to believe; but, by faith I cannot be made to understand. That we should not receive that as an historic narrative, which is nothing but an apologue, I will readily assent to; but, at the same time, I must be permitted to maintain, that it is not wise to refuse all historic faith to what is traditionally given. But I will not animadvert in the manner that the hardiness of the principle might successfully enable me to do; nor in the manner, perhaps, which its dangerous tendency might justify.

When I read of the first voyages into the Ægean, Euxine, and Mediterranean Seas, made by the various adventurers, who were afterwards (though of different nations, and certainly living in very distant periods) tied up together in that historic bundle called the Argos; canonized as a sign in the heavens, and who were called Argonauts; whether that story be meant to describe the progressive voyages of a nation, or whether the actions of a particular band, or a series of adventurers, Greeks, Syrians, or Egyptians; when I read this, and compare it with the voyage of Columbus, and those of other adventurers, I am at no loss to understand the

nature of the adventures. * When I read of settlements on the coasts, in the islands of the Archipelago, or the shores of the Euxine, particularly the great settlement at Colchis, I am at no more loss to comprehend them, than I am the settlements of the Portugueze in Asia. When I read of the travels and conquests of Osiris, Bacchus, and Sesostris, the various Herculeses, and such like characters, and compare them with similar travels, voyages, adventures, and conquests, of Cortes, Pizarro, and Albuquerque, (for I shall not here touch upon the physical interpretations of the principles which first bore these names) how is it possible not to see the real history, through the veil of metaphors and allegories, which have apparently transformed it into fable?

But, says the antiquary, † in the account of the Argo, we have undeniably the history of a sacred ship, the first that was ever constructed. This truth the best writers among the Greeks confess, though the merit of the performance they would take to themselves. Yet, after all their prejudices, they still betray the truth; and shew that the history was derived to them from Egypt. Accordingly, Eratosthenes tells us, "that the

* Pownall. † Bryant.

the asterism of the Argo in the heavens, was there placed by Divine Wisdom; for the Argo was the first ship that was built: και αρχηθεν επεκτονηθη. It was moreover built in the most early times, or at the very beginning, and was an oracular vessel. It was the first ship that ventured upon the seas, which before had never been passed: and it was placed in the heavens as a sign and emblem for those who were to come after." Conformably to this, Plutarch also informs us, that the constellation which the Greeks called the Argo, was a representation of the sacred ship of Osiris: and that it was out of reverence placed in the heavens. One of the brightest stars in the southern hemisphere is placed on the rudder of the ship. This star, by the Egyptians, was called Canobus, which was one of the titles of their chief deity; who, under this denomination, was looked upon as the particular god of mariners. There was a temple upon a branch of the Nile, called by Stephanus, Ἱερον Ποσειδωνος Κανωβε, the Temple of Canobus Neptunius, the great god of mariners. Over against it was a small island, called Argœus. But, what more strongly proves its having come from Egypt is, that in all the celebrated places in Greece it was utterly invisible. The sphere consequently could not

have been the work of a Grecian; nor could the asterism have any relation to Greece.

The Greeks, I believe no one will deny, had vanity sufficient, and pretensions in every respect, paramount to their neighbours. But, the Argonautic expeditions do not seem to have been attended with those very marvellous circumstances, which would render it probable they should have stolen the tradition of them from the Egyptians. The voyages, indeed, are fabulously narrated, but are they not as easily to be understood as any other tales of former times? "In the mountains of the kingdom of Phrygia," says Strabo, "and near to the spot where the Xanthus took its rise, were many considerable mines of gold. This gold, or gold dust, washed by the torrents from those mountains, settled in the beds of the adjacent rivers. In the earlier ages, it was the practice to sink in such rivers a certain number of fleeces, by which means they collected this precious metal in considerable quantities, and hence the fable of the Golden Fleece." Now, were any of the Argonautic expeditions more inexplicable than that which led to this very simple and not improbable story?

But,

But, biassed tenacity will immoveably cling to its favourite object. The transformation of the Argo into the ark was not enough. Other collateral circumstances were therefore resorted to. "The ancients," says Bryant, "were in general Materialists, and thought the world eternal." But, the mundane system, or at least the history of the world, they supposed to commence from the deluge. Thus, as the ark and deluge were of the highest antiquity in the mythology of Greece, and as every thing was deduced from that period, *Archaia* hence came to signify any thing very ancient, and Αρχα the beginning. "The ark was indisputably looked upon as the womb of nature," says he, "and the descent from it as the birth of the world." On this account, under the character of *Rhea* and *Cybele*, the genius of the ark is styled *magna deûm mater, materque terrarum.** "But, that which uncontrovertibly establishes the opinion, and that which was the most pleasing emblem among the Egyptians of the deluge," continues he, "was the exhibition of it, under the character of Psuche, Ψυχη. This was originally no other than the aurelia, or butterfly; but, in after times, was represented as a lovely female child, with the beautiful wings of that insect.

* Lucretius.

insect. The aurelia, after its first stage as a worm, lies for a season in a manner dead, and is inclosed in a sort of coffin. In this state of darkness it remains all the winter. But, at the return of spring, it bursts its bonds, and comes out with new life, and in the most beautiful attire. The Egyptians thought this a proper picture of the soul of man, and of the immortality towhich it aspired. But, they made it more particularly an emblem of *Osiris*, who, having been confined in an ark or coffin, at last quitted his prison, and enjoyed a renewal of life. And as the whole was owing to divine love, of which *Eros* was an emblem, we find this person often introduced as a concomitant of Psuche. *

The Scriptures, on the subject of the deluge, speak with all the evidence and demonstration of truth; of truth, however, which must be taken, as we have already seen, in a circumscribed, and not in a general sense. When, on a former occasion, we enquired into the nature and properties of the atmosphere, it then was physically clear, that though the whole contents of the atmosphere were water, and that they were precipated on the earth, yet, that then there would not be a sufficiency to reach to the

* Anc. Mythol.

middle of Mount Jura: no, not even though the waters of the ocean were added to those of the atmosphere, and formed into one common mass. But, supposing the Armenian mountains covered with water, unless there was a miracle to keep these waters in heaps, they would flow throughout the earth; for these mountains are high enough to make them fall every way, and make them join with our seas. We cannot imagine hills and mountains of water to have hung about Judea, as if they were congealed; or a mass of water to have stood upon the middle of the earth, like one great drop.* All liquid bodies are diffusive. Wherefore, when these waters began to rise, long before they could swell to the height of mountains, they would diffuse themselves every way; and therefore, all the vallies, and plains, and lower parts of the earth, would be filled throughout the whole earth, before they could rise to the tops of the mountains in any part of it. The sea also would be raised to a considerable height before the mountains could be covered. We might as well expect that the lake of Geneva should swell to the tops of the Alps, on the one hand, and the mountains of Switzerland and Burgundy on the other, and *then stop*, without overflowing the

* Burnet.

the plainer countries that lie beyond them, as to suppose, that the waters should rise to the tops of the mountains in one place, and not diffuse themselves equally into all countries about, and also upon the surface of the sea.

The deluge then was most probably partial, and confined to the countries inhabited by the Adamic race of man. But, upon the mountain of Ararat, in Armenia, which is a part of that vast chain of mountains, called Caucasus, and in the countries adjacent, it is said, there are more authentic accounts preserved of the ark, than in almost any other part of the world. "Cæterum veteres Armenii in carminibus suis, cantilentis ad cymbala ac tripudiis, longè copiosiorem de his rebus mentionem agitant." "The ancient Armenians, in their poems and hymns, which are accompanied with cymbals and dances, afford a far more copious account of these events than any other nation." * However this be, there is strong ground for the supposition, that the Ararat of Armenia could not have been the Ararat on which the ark rested; for it is expressly said in Genesis, "that all the high hills that were under the whole Heaven were covered." And further, "that the ark rested in the seventh

* Bryant.

month, in the seventeenth day, on the mountains of Ararat; that the waters decreased continually until the tenth month; and that in the tenth month, on the first day of the tenth month, were the tops of the mountains seen." Now, from these passages, it would seem that Ararat must have been infinitely raised above all the other mountains of the globe, its top being ready for the resting place of the ark, so many months before the others were seen, at the same time that "the waters retreated from the earth continually." But,* though the Sacred Text fixes the name of the mountain, it yet is far from determining, with precision, the country in which it was placed. Sir Walter Raleigh, indeed, thought he discovered the error into which mankind had fallen, in supposing that Mount Ararat was in Armenia. "This Ararat, situated to the *north* of the plains of Shinaar, could never," says he, "have been the place whence the people could gather together from the *east*, as is expressly said by the sacred historian." The real Ararat consequently must have been to the *eastward of Babylon*, and a part of the Caucasus, which extended as far as to the *Imaus* of the ancients. Nor is this without proof, even from the authority of the Hebrew, as well as from that

* D'Hankerville.

that of the Heathen historians. For when the sons of Noah descended from Ararat, they advanced towards the Euphrates and Babylonia, and took exactly the same route, which, the sacred historian says, the Scythians did, when moving into the plains of Shinaar, and from the parts whence the most ancient people are said by the Greeks to have been deduced.

If, in the admission of certain physical facts, from the text of the books of Moses, men would allow themselves the free exercise of their reason, and the free application of it, when unsophistically established upon experiment and observation, the many mistakes which have proceeded from credulity, would not have been in circulation; nor would the opprobium of imposition have been exultingly laid on venerable characters, by the wanton and the uncandid. But, there has been unquestionably too blind an attachment to the very letter of the law; yet, as in common things in life, the least mistake, a various pointing, a parenthesis, a lettter misplaced, may alter the sense, and render the truth of a circumstance in many respects doubtful; why should we be so obstinately wedded to the infallible correctness of voluminous writings, which have been so often transcribed by men,

who *never saw the original*; and by men too, who, even in the earliest times, have been acknowledged to have dealt in apocryphal and very fallible expositions? It is too unreasonable to insist on an unqualified faith in points, in which the great concerns of Christianity are in no wise interested. A proposition, the terms of which are unintelligible, is an absolute mystery. To say we are bound to believe mysteries in this sense, is in itself extravagant; but, to say that we do believe them, may, I am afraid, awaken a suspicion of something worse than extravagance.

"Among the nations who have adopted the Mosaic history of the world," says Gibbon, "the ark of Noah has been of the same use, as was formerly to the Greeks and Romans the siege of Troy. On a narrow basis of acknowledged truth, an immense but rude superstructure of fable has been created; and the wild Milesian, as well as the wild Tartar, can point out the individual son of Japhet, from whose loins his ancestors were lineally descended. Europe has abounded with antiquaries of this profound learning, and of easy faith, who, by the dim light of legends and traditions, of conjectures and etymologies, conducted the great-grand-children of Noah from the Tower of Babel

to the extremities of the globe. This, I agree with Mr. Gibbon, has undoubtedly been the case in variety of instances, and is very fairly to be compared to the second class of poets among the Greeks, who with the Iliad of Homer, amplified the episodes of the divine old bard, and separately brought them into action; and thus, as it were, out of his limbs formed their own bodies. What he had contracted they enlarged. Out of one Hercules they made infinity of pygmies. Each, indeed, they endued with human souls; for, from him, their great Creator, they each of them had the "divinæ particulum auræ." They flowed from him at first, and were at last resolved into him,* as the common source. I do not mean, however, to assert, that legends, traditions, conjectures, and etymologies, are to be altogether laid aside. In some cases we shall find them of utility. In many, they have come in to the aid of the most manly and the most impartial historians.

* Dryden.

LETTER XLVI.

THE lights which the sacred writings have cast upon the history of man, however figurative, or however occultly they may have been interpreted, have assisted us in reasoning upon our present existence, as well as on the hope which soars to an immortality. The periods, in which we had no being, and those in which that being shall be changed, and rendered different, are abysses which are unfathomable. The merest ignorance is here as well informed, as the mind of the deepest comprehension. Placed besween these awful points, one of which saw us born, and the other of which shall see us die, the inevitable clouds of uncertainty hover around each termination. Our curiosity may lead us to investigate them, but our sole business is to fill up the interval well, by a virtuous course of action. Yet, notwithstanding the confines to which we are thus limited, the order of Providence does not seem to command us servilely

servilely to adhere to what has been said four or five thousand years ago; to judge of eternity by a day; to reduce time to a positive epoch; or, in a word, to bind the force of nature in our own imbecility. Can it be enjoined us to believe the more, for the very reason why we should believe the less? "God and nature," says a learned prelate, * "have prescribed a clear remedy against credulity and illusion, the use of reason, which may examine the grounds and testimonies of all that has been handed down to us; inquire into their truth; and after a scrupulous trial, pass sentence upon them." This, the interest of truth, and the honour of our nature, requires us to perform, that we may neither prostitute the former, nor depreciate the latter. Without this prudent enquiry, our belief would become criminal; for to violate the rules of conduct prescribed to our understanding, were to overthrow all the laws of nature, to debase the dignity of mankind, and to efface the image of God implanted in us. In fact, to admit any thing as a revelation coming from God, which contradicts the evident dictates of our reason, is to sacrifice one revelation, and that which God gave us with our very beings, to make

* Bishop Stillingfleet.

make way for another, which is inconsistent with it.

The passive faith of mankind, in general, readily yields assent to any thing handed down as supernatural. Human credulity is not easily satiated. Thus, even in religion, every mode to make a deep and lasting impression, must, it is said, exercise our obedience, by enjoining credance in opinions, for which we can assign no reason, but must acquire our esteem, by inculcating moral duties analogous to the dictates of our own hearts. But, pure faith is nothing but a species of reason; as religion is but the sublimest branch of philosophy. And hence a chain of argument, similar to that which establishes any truth in morals, politics, or physics, is equally essential in the discovery of the principles of theology, natural and revealed.* Revelation, indeed, descends like a torrent, and bears down all before it, whilst the tradition of it is fresh and strong. But, this force diminishes gradually, the stream grows feeble, and ceases at last to run, by a necessity arising from the nature of things. On the contrary, the stream of which reason is the source, may be obstructed in its course. It may

* Locke.

may creep, scarcely perceived, in the same channel, or it may disappear entirely; but, when it no longer rolls on the surface, it runs under ground, and is ever ready to break out afresh.

Affected, or injurious singularity, is, on every occasion, and on every subject, disreputable; for it infallibly marks pride, vain-glory, and a contempt of the opinions of others. But, where there is only common or unpresuming error, it is charity to conclude, that men's hearts may be sometimes better than their heads; and that their wanderings may be more owing to the confusion of their understanding, than to any real intention or design to invalidate the principles of reason. To what are we to atrribute that zeal, which would secure by force a fictitious uniformity of opinion? Or how are we to approve of those restraints, that are professed enemies to the progress of knowledge, which would have all discoveries carefully suppressed, and would impose upon Christianity a blind adherence to the traditions received from its fallible forefathers? Can it be an injunction from heaven, that we are never to gain more knowledge, nor ever to grow wiser? And what reason can be assigned, why we should not reject the mistaken

takes of our forefathers, as they rejected those of the church of Rome, and of their forefathers? * They who are afraid of new light, and increasing knowledge, seem to betray a bad cause, and to be conscious that their opinions will not stand the test of a severe examination.

In the pursuits of philosophy, naturalists have built immense systems of imagination, on a few sensible phænomena, inaccurately observed very often, and not always very fairly recorded. Divines have done the same, on a few intelligible and unintelligible passages, picked up here and there in the Scriptures, and connected as their purposes have required. The first have not stopped where the phænomena ceased; nor the other, where the Scriptures have been silent, or have not spoken clearly, which ought to be reputed the same, and to check our presumption alike. On the contrary, where they have had no rule to go by, like men freed from restraint, they have gone the greatest and boldest lengths. † Truths, indeed, it must be confessed, even those which have been discovered in the most enligtened ages and countries, have been so blended with the errors of the darkest, that like the ores of a rich mine, they must be separated and sifted with

* Bishop Law. † Bolingbroke.

with the nicest discrimination. But, what are we to think of those men, who pretend to face, like so many intellectual eagles, the sun of Eternal Wisdom, and to pry into the essence and energy of first causes?

No hypothesis, that is advanced with decency on the system of the world, can be in any manner injurious to religion. On principles not to be shaken hath truth been founded. Nor can an erroneous conjecture serve otherwise than to make religion appear with additional glory. False surmise can never wrest its authenticity from well-established fact. Novelty, indeed, may strike for a moment. But, that which is, will always fix itself in conviction, while that which might have been, will disperse into those regions of uncertainty, whence it originated.

With regard to the æra of the commencement of the race of mankind, or how this globe primevally was peopled, are points which I must confess are to me inscrutable. "There are but two ways," says Burnet, "to account for the peopling of the earth---the inhabitants must either have come from heaven, or have sprung from the earth." But natural reason cannot determine upon either of them; no track is left to it to follow, in such unbeaten paths,

nor

nor can it advance one step farther even in conjecture. An anterior or primitive people, it is possible to attempt to prove, but the task is difficult. When we remount to the distance of four thousand years, we find little else than darkness. If some faint rays discover to us inhabited regions, monuments destroyed, and the footsteps of men, the difficulty of tracing those venerable vestiges of time would almost stop us in our career. It is a promised land, which we are permitted to see at a distance, but which we are never thoroughly to enter. Physical appearances attest the high antiquity of the globe; and nations have perished who have no longer a name. Nay, there is not any where a large portion of land, that has been discovered destitute of present inhabitants, or of the relics of former population. The earth, indeed, we inherit as our patrimony, but not so much like rightful owners, as like the descendants of cast-away travellers, who have been thrown by tempests and shipwreck on a new shore, leave but an imperfect recollection of their disasters, and transmit scarcely a memorial of the natal regions of their fathers. In the revolutions of time, tradition loses its influence. Attachments arise to visionary speculations, and fable becomes substituted for common casualty and distress. Even those,

from

from whom we derive all we do know, had not that fund of knowledge, as the immediate produce of their own ability. What they had they borrowed. Their learning and philosophy consisted more in conclusions than in demonstrations. Of many of the truths they possessed, they knew not the premises, nor the proofs; nor can any thing be more convincing, that their wisdom was not of their own invention, * nor such as they came to by fair reasoning and observation upon nature; but, that it was delivered to them by others, or by ancient story. Nor are arts themselves altogether to be considered as arguments for or against the high antiquity of the world. The blossoms of each must repeatedly have perished, when generations succeeded generations, without the least progress of improvement; while all, setting out from the same point, whole centuries must have elapsed in the ignorance of primitive ages, and the species have already grown old, while the individual still continued in childhood.

But, the late invention of the arts, and the shortness of the histories of the earth, are invincible arguments, it is contended, against its being of any great age. This, I acknowledge, has some weight.

* Burnet.

weight The investigation, I should however apprehend, would rather give it a local than an universal acquiescence.

If the world were greatly anterior to the epocha of creation, as given us by Moses, you must needs say, its opposers make the people of those days a race of unheard of inability, for there is hardly any useful art or science, but we know its origin and progress, and its first inventor, or at least its first introducer into this or that part of the world. Could Greece, it is asked, be for numberless ages without the common tools of the carpenter, the saw, the augre, the plane, and the plumb-line, until Dædalus had the happiness to invent them? Did mankind for ever live upon roots and herbs, till Ceres, or which is the same, the Egyptian Isis, found out the sowing wheat and barley? Were wine and honey not known till Bacchus shewed them to the world? Did no one know how to cut and polish stone, till Cadmus taught it? Had the Romans any thing so scientific as a sun-dial, even during the second Punic war? In a word, it is altogether incredible, they urge, that mankind should have continued so many thousand years, and never have found out any thing useful to themselves. The argument of the arts

only

only being revived, is at best but a lame one. Curious arts may, indeed, have been lost and revived. But, who can imagine that the art of the smith or the carpenter should ever have been forgotten, unless we could suppose that houses and all sorts of domestic utensils could have grown out of fashion, or that it could have become the mode for men to have lived like colts and wild asses? Unless the children of nature can be supposed to have forgot the use of eating and drinking, it is impossible to conceive they could have forgotten the arts of ploughing and sowing, and of pressing the grape. *

To all this it is replied, that in the earliest ages of society, untutored children of men first erected cabins, covered with branches, grass, and briars; little did they imagine that these, their first essays, would draw into existence cities of miles in circumference. He who invented an alphabet, never dreamed of a library as large as that of Alexandria. The progress of an art is a mystery to those who first practise the rudiments. There has been no first physician, statuary, architect, or astronomer. An art is nothing but the result of knowledge, acquired on a certain subject; and the acquisition of know-

* Conf. with a Theist.

ledge is the fruit of time, and the industry of many men.* The fact is, that even the progress of the arts can, in no just manner, ascertain the age of the world. Two thousand years have, since the beginning of history, passed over the nations of Africa, and yet they are not polished from their natural barbarism. Some ages, indeed, have been marked by the fruits which they have diffused abroad, and by the influence which they have had on the welfare of mankind. But, even this, as I have already said, must not be looked upon in an universal, it must be taken in a limited point of view. Newton shews, that what we understand by the Copernican system, was a system almost as old as the Israelitish æra of the world.

Mankind, in every period of their story, seem only capable of carrying down certain accounts of themselves, through certain portions of time. But they, who measure the age of the world by the progress which the arts of civilization have made, seem not to have attended to the natural instability of human affairs. In the gloomy space, behind the revival of arts, posterity place the origin of mankind. The prospect sets upon the sight at that point, and they fondly imagine, that no

* Saint Etienne.

no portion of existence lies far beyond their view. But, shocks have happened to this globe, which have repeatedly expunged from its face the feeble monuments of civil improvements.* Were instances required on this head, they might be amply detailed. But we will confine ourselves here to one, and that a very familiar one. Coals, oils, and all bitumens found in the mineral kingdom, owe their origin, as we have already seen, to animal and vegetable remains; for such only can produce those inflammable substances. In the strata of coal, as well indeed as in the strata of other fossils, how clearly do the irregularities, gaps, and breaks, evince that this globe has undergone the most violent convulsions; that its parts have been broken, detached and overturned in different ways, *burying large tracts of the upper surface*, with all its existing animal and vegetable productions; and that the various heaps and congeries of these vegetables and animals, remaining ages upon ages in the bowels of the earth, have obtained the various consistencies, in which they exhibit themselves, in oily and bituminous juices! † But, step still a little farther; and as, at the profound depth of two and three thousand feet, we can trace what was once the surface of the earth, as well as in its superincumbent

* Macpherson. † Magellan.

strata, what were in after times the beds of the ocean; so can we in climbing the summits of the Alps, as satisfactorily ascertain, that above the Alpine tops the waters rolled, and the seas were navigated.

What emotions doth this reflection excite! How far beyond itself doth it plunge the contemplative mind! But, arrived on the rugged side of *Mont Blanc*, if one but casts a thought on the formation of the neighbouring mountains, their age, their succession, the causes which could have accumulated stony elements at a height so considerably above the present surface of the globe; if one scrutinizes into the origin of these elements, the revolutions they have undergone, and those that await them, how sublime the subject, how greatly beyond the perfect grasp of comprehension! Yet, such has been the fate of this globe, that a reversion of system would seem to have taken place in it. In the very heart of the earth, now overloaded with marine and volcanic strata, we come to soils on which man has walked as on the surface. Many thousand feet above it, fishes afterwards have as evidently sported, and the seas have had dominion. Under these circumstances, may we not be warranted in concluding, that

that no two planets, under the same state or period, do, perhaps, so much differ from one another, as our own planet doth from itself, in *different periods of its duration.** It is not the same world the first men inhabited, that we seem to inhabit; nor are we, perhaps, of the same texture with them.

One constant rotation from existence to non-existence, or from generation to dissolution, and so back again, seems to maintain our world and the inhabitants of it in being; and the same rotation of worlds, and systems of worlds, maintain perhaps the universe in being. But, besides the proof arising from bituminous strata, there have been others adduced, which are equally striking. "If the waters anciently covered the surface of our globe," says De Saussure, "and gradually retired, there must have been a time when the highest mountains, *Mont Blanc* for instance, were islands in the midst of the ocean. Those islands at that time, being but inconsiderably elevated above the surface of the water, must have been blessed with a temperate climate, have been covered with a vegetable earth, and have been productive of fruits and grains. The flux and reflux of the sea, in-

 deed,

* Burnet.

deed, the violence of the waves and rains may afterwards successively have dragged away this earth, and deposited it in beds. But, in divers places in the Alpine vallies, naturalists have believed they could fix upon the remains of this vegetable earth; and the idea was certainly an ingenious one.

As we have already seen, the chains of mountains are composed, as it were, of three bands; the first of granite, the second of schistus, and the third of calcareous matter. "Of this formation," says Pallas, "are all the prodigious mountains which run through the Russian dominions." Of the mountains of the Tirole, and in fact of every part of Europe, Ferber says the same. The Pyrenees, however, shew it more positively than any other. Granite forms the *nucleus* of the Pyrenees. Many of them have it for the base on which they stand. The most elevated part of *Gavernie* is calcareous, as is the highest pinnacle in the neighbourhood of the valley of *Luchon*, which is the highest of the Pyrenees, and these both lie on granite foundations. Recollect the delightful road through the valley of Campan, from Bagneres to Grip; thence by the Pick d'Espade to Barege, and so on to Lourde: every step of the way bears strong testimony

testimony to the truth of the hypothesis, and manifests the light in which granite should be considered.

Mould and turf are from animals, vegetables, shells, &c. * and all kinds of them contain a portion of the inflammable substance, which has remained in them from those animals and vegetables; and they are more or less black, in proportion as they contain more or less phlogiston. They in general serve as an uniting medium between the three kingdoms of nature; and it may reasonably be asked, if all sorts of earths do not, in form of very minute particles, enter into the composition of vegetables and animals; after which, they exist for some time in the form of mould, until the phlogiston be again separated? There is great probability, indeed, though it be not easily demonstrable, that common clay, and especially the blue, grey, and pale red, which are often found in the soils of plains and dales, bordering upon lakes, hath its origin from mud; and that mud owes its existence to vegetables; consequently, that these varieties of clay are nothing else than a mould, or *humus ater*, the earth, in which vegetables thrive best; but, somewhat altered by means

* Cronstedt.

of water, and the action of other causes. The following circumstances strengthen this opinion: "A great quantity of plants," says Cronstadt, "rot every year in our lakes, and are changed into mud; and the clay begins where the mud ceases." Turf, or peat, likewise, is known to be produced from vegetables, and is cut in humid or low marshes. And the quantity of iron, often found in clays, is, in general, only in proportion to the quantity that enters into the constitution of vegetables.

In different regions of the earth, different strata are thus to be found. All are not alike. Yet, analogy may in general be admitted; as in a given extent of country it has been proved, that the arrangement of its strata as invariably prevails as a series of numbers; insomuch, that by knowing the incumbent stratum, together with its arrangement in any particular spot, a perfect knowledge is at once obtained of all the inferior beds, * that is, to the depth to which they have at present been examined. On this subject of subterraneous geography, much hypothesis hath been built. But, it is not necessary for us to enter into minute details; it will be quite sufficient if we can in one instance ascertain

* Whitehurst.

tain what is most probably the case in many. In the county of Derby, for instance, the strata were not long ago examined by the late Mr. Whitehurst, to the depth of about 1500 feet; and he found the following order in their disposition:

Millstone grit, the upper stratum, to the depth
Of - - - - - - - 360 feet.
2. Shale - - - - - 360
3. Limestone - - - 150
4. Toadstone - - - 48
5. Limestone - - - 150
6. Toadstone - - - 138
7. Limestone - - - 180
8. Toadstone - - - 66
9. Limestone, not cut through

From the strata, which we find thus regularly arranged, however dissimilar in their natures, many conjectures have been raised as to the antiquity of the globe. In particular, the volcanic strata have arrested attention, and hence, the *Canonico Recupero* says, two thousand years at least are required to convert a stratum of lava into a fertile field; or one capable of producing corn and vines. But, the times necessary for converting lavas into fertile fields are not so arbitrarily

bitrarily to be determined, for they must be different, according to the different consistencies of the lavas, and their different situations with respect to elevation or depression; and to their being exposed to winds, rains, and to other circumstances.* Now we have proofs of *seven* different lavas, with interjacent strata of vegetable earth, which have flowed from Mount Vesuvius, within the space of somewhat less than seventeen hundred years; so that, according to these, a stratum of lava may be covered with vegetable soil in about two hundred and fifty years, instead of requiring two thousand for the purpose.† Conjectures, thus hazarded, however ingenious, can never pass for argument; nor can a fanciful supposition militate against what is said to have history and tradition in its favour. Earths and stones seem evidently to consist of the same principles. They are by turns converted into each other; nor can the true difference between a stone and an earth be positively pointed out, either in regard to hardness, or to softness: for where is it that common chalk finishes, and the limestone begins? And how is a clay to be distinguished from the smectis or soap-rock? ‡

In

* Bishop Watson. † Sir W. Hamilton. ‡ Magellan.

In most of the limestone quarries which are to be seen, we are presented with prodigious collections of petrified sea bodies, as the bones of fishes, stalks of sea weeds, vast quantities of shells, and other marine productions. No spot at the bottom of the ocean could exhibit a more discriminate assemblage of sea bodies, than are at times to be found in these solid rocks; for we have the skeletons of several fishes, the antennæ of lobsters, the roots and stems of sea weed, with the very *capsulæ* which contain the seed. Now, from these, two or three observations necessarily follow. First, that among all these bodies, there are none but what are specifically heavier than water: this holds so constantly true, that the sea weed which floats in water when the plant is entire, has been stripped of its broad leaves, which made it buoyant, before it had been lodged there. Secondly, that the shells have been all empty; for the bivalves, especially those of the flat kind, are generally found single, or with one side only. And thirdly, that these rocks were in consequence created at the bottom of the sea, and then became dry land. In like manner, they all dip towards the sea; and all lie in flakes of unequal thickness.*

But,

* An. Reg. 1760.

But to descend from great things to small, this is in fact the case with various stones, and with all crystals and gems; for they are all found to be of a foliated or laminated structure. As for instance, whenever the edges of these laminæ are sensible to the eye, they have a fibrous appearance. But all rocks, where these extraneous bodies are found, seem to be formed from the common sediment of the sea; as of sands of several kinds (for sand is nothing else, than very small stones) with the bones of fishes, stalks of sea weed, and empty shells, which are all rolled into beds by the agitation of the water. These different bodies, thus blended together, are, by the violence of the flux and reflux, banked up towards the shore, which is the cause of the inclination or dipping of the rock. No sooner is one stratum laid, than, by a continual accession of the same matter, a second is superinduced; and so on successively, till the mass has reached a certain height in the waters. These loose materials, as soon as the vegetation commences, become fastened by a strong cement, and assume the consistency of stone. For the petrific matter fills up all the interstices, pervades the pores of the solid bodies, and lodges every where the particles that enter into its own composition: which seems to be a fixed salt, or very powerful astringent,

gent, or as in the case of the bath and many other stones, an *aerial acid*, which, on their being exposed for any length of time, they attract from the atmosphere: and these may be farther assissted by a mixture of mineral juices or metallic ores, which run in small veins, in several places of the rock. The shells being of a close and compact texture, and therefore refusing admission to the grosser parts, seem to have received only the finer parts of the mixture, which has converted them into marbles, and into a transparent substance something resembling a crystal. The sea weeds, of a more porous and spungy nature, have imbibed the whole lapidific matter; which has changed them into a fine white substance, capable of a very high polish. The like may be said of all the other bodies, as they are more rare or dense in their texture; and fitted to receive more or less of the petrific matter. And hence it is not impossible, that rocks which are now in a ductile state, will to future ages, occasion the same speculations, that their elder brethren of Derbyshire have done to us at this moment.

On the Continent, as well as in Great Britain, considerable strata of *creta alba* are to be observed, in which flint is deeply imbedded. But,

as yet no one has been able absolutely to prove that chalk and flint are of the same constituent parts: at the same time, that the loose flints which are scattered over the surface of the earth, would seem to indicate, that they have been by some means transported from their native beds. But, in the waters of the sea, it is almost incredible what quantities are contained of dissolved calcareous earth.* Nor is the petrifying quality of sea water less remarkable. A Gentleman at Boulogne, in the summer of 1750, observed that the British Channel, which washes the bottom of a hill near that place, had worn in through great part of the hill, which consists mostly of a mixed sand, with about three or four feet of a strong blueish clay. As the sandy part was washed away, the clay fell down in large masses, and, as the inhabitants affirmed, was petrified by the sea water. Walking one day on the sands, this gentleman saw a large lump of the clay which had fallen from the hill, and so lying, as to be washed by the tide. He impressed a mark on it with his cane, it being then in a very soft state. But, passing the same way about three weeks afterwards, he could not force his cane into the same lump.† This is a remarkable instance of speedy induration. But, it would perhaps be too rash

* Magellan. † An. Reg. 1760.

rash to affirm, that all petrifications are so quickly to be brought about.

From all, however, that we have thus said, though we have neither history nor tradition, which can assist us in the inquiry, yet still the fact of the sea having *covered our highest mountains*, is to be ascertained from indelible monuments, and more to be depended on than any human testimony whatever. Secondary mountains, or those which lie in strata, as we repeatedly have had occasion to observe, have all the same inclination, and the same mixture of shells, &c. as the rocks which stand within low-water mark. What can we conclude then, but, that the former once stood as the latter stand now? Why may we not assume it as a certainty, that they have risen successively in the sea, as the only proper matrix for such productions, and the only place, too, where the *materials that enter into their composition are to be found?* In short, by means of these petrified sea bodies, we trace the waters which drowned the old world like an enemy, who in his retreat leaves his spoils behind him. When all other helps fail, historians produce medals and old coins, as authentic evidence of certain facts. In like manner, why may not

we

we look upon marine accumulations, turned into Alpine heights, as undeniable proofs of a fluid origin, and of an oceanic growth?

LET-

LETTER XLVII.

IN the intricate pursuit in which we are now engaged, I confess I feel myself like a traveller without a guide in an unknown region; at every turning, obliged to explore my way; and consequently impeded at almost every step of my journey. But, as I would not mislead you, could I avoid it, so would I be conducted in these paths, by superior knowledge and observation. Under their direction, I would discharge the duty I have imposed upon myself. From just physical principles, utility is alone to be derived. Men readily enter into speculations on data which are assumed, but, if no physical existences correspond with those data, no truth can be ascertained, nor any mental satisfaction be obtained. While we investigate these vestiges, as it were, of another world, how natural for us to reflect on the instability of this transient earth! How natural is it to reflect, that by the force of one element breaking loose upon

the rest, all the vanities of nature, all the works of art, all the labours of men, are reduced to nothing! All that was admired and adored before as great and magnificent is vanished, or obliterated; and another form and face of things overspreads the whole! "Where are now," will some future philosopher say,—"where are now the great empires of the world, and their great imperial cities, their pillars, their trophies, and their monuments of glory? Shew me where they stood; read the inscription; tell me the victor's name. Rome itself, eternal Rome, the great city, the empress of the world, whose domination, ancient and modern, makes a great part of the history of this earth, what is become of her? She laid her foundations deep, and her palaces were strong and sumptuous. But, her hour has come; she is wiped from the face of the earth, and buried in everlasting oblivion. But, it is not cities only, nor the works of men's hands, but the everlasting hills, the mountains, and rocks of the earth shall be melted as wax before the sun, and their place shall no where be found. Here stood the Alps, the load of the earth, that covered many countries, and reached their arms from the ocean to the Black Sea; this huge mass of stone is softened and dissolved as a tender cloud into rain. Here stood

the

the African mountains; and Atlas, with his top above the clouds. There was frozen Caucasus, and Taurus, and Imaus, and the mountains of Asia; and yonder, towards the north, stood the Riphæan hills, cloathed in ice and snow. All these are vanished, and dropped away as the snow upon their heads." *

"The primitive state of the earth," says Whitehurst, "seems to have been totally metamorphosed by the first convulsion of nature, at the time of the deluge; its strata broken, and thrown into every possible degree of confusion and disorder. Hence, those mighty eminences, the Alps, the Andes, the Pyrenees, and all other chains of mountains, were brought from beneath the great deep. Hence, the sea retired from those vast tracts of lands, the continents; became fathomless, and environed with craggy rocks, cliffs, and impending shores; and its bottom spread over with mountains, and vallies, like the land." The irrefragable arguments, which we have already noticed, to prove the formation of the Alps in the bosom of the ocean, will have sufficiently strengthened you in the conviction of their aquatic origin. The summits, indeed, of most of them, in particular

* Burnet.

of Mont Blanc, is entirely covered with snow. Nor can any rock be observed for four or five hundred feet. But, the most lofty points discernable, are granite: those on the east side, blended a little with steatites; those on the south and the west with schoerl and hornstone. But, one of the very highest of all, is evidently composed of vertical laminæ.* These strongly-marked testimonials evince, that desolation has been spread abroad, and that the outward frame of this earth has fallen and sunk in. "Every valley shall be exalted," says Isaiah, "and every hill and mountain shall be laid low." Even so with the Alps. See how scornfully they look down upon you, and bid defiance to the elements. For innumerable ages, they have borne the thunder and lightning of heaven, and all the artillery of the skies. Let the towns and cities of the earth, say they, be laid in ashes: these things will not affect us.—Yet these mountains shall also have their fall; nor shall a wreck of them remain.

From all that we have thus said, it is nearly demonstrable, that the globe could not have been always in its present terraqueous form; and that there consequently must have been an ante-

* De Saussure.

antediluvian world. L'Abbè de la Pryme, in a letter published in the Philosophical Transactions, dated in the year 1700, * expresses himself as follows. "My opinion is, that there was an antediluvian world; that it had an external sea, as well as land and mountains, hills, rivers, and fruitful fields and plains; that it was about the size of our present earth; and that when God had a mind, for the wickedness of the inhabitants that dwelt therein, to destroy the same by water, he broke the foundations and subterraneous caverns and pillars thereof, with most dreadful earthquakes; and caused the same to be, for the most part, if not wholly, swallowed up and covered by the seas that we have now; and that this earth of ours did then rise out of the bottom of the antediluvian sea, in its room." There is a passage in Josephus, which some may think countenances the notion of the ancient continent having been changed into the present sea.† He says, "God, at the time of the deluge, changed the continent into sea, so that all men were destroyed."——Εις θαλασσαν την ηπειρον μετεβαλε, και οι μεν ουτως αφανιζονται παντες. "The parts," says Leibnitz, "the most elevated of the ancient world, sunk in suddenly into caverns full of water, which disgorging upon the earth, the

* No. 216. † Bishop Watson.

globe was covered, and hence the deluge. Other caverns, again, served for the retreat of these waters, and thence the dry land. Nor can this, says he, be looked upon as improbable, when it is considered that the plains the most elevated on the earth, are not, perhaps, more than twelve or fifteen hundred feet above the surface of the ocean." But here Leibnitz was in an error, as we shall presently shew.

The continents, as we have already seen, which we inhabit this day, are, to all intents and purposes, like the bottom of the sea. But, the way in which they became continents, is variously explained. Some say that the flux and reflux of the ocean carries the waters continually from the west to the east; that the action of the sun causes an easterly wind, more frequently than any other; and that that wind urges the waters in the same direction: that consequently, one part is in a state of daily destruction, and the other of daily increase. Others insist, that the earth washed into the sea by rivers, torrents, rains, and the lashing of its shores, must in time elevate its bed; and consequently, while the land proportionably dwindles away, that it must at length so considerably accumulate as to become inhabitable. But, these

are slenderly built hypotheses. Nor can any thing be much more preposterous than the supposition, that waves breaking against a shore; that a tide of an elevation of fifteen or twenty feet; or that small wrecks of soil carried into the sea by rivers, should raise mountains of fifteen thousand feet above the level of the ocean. At the same time, it is not to be denied, that tides, necessarily striking against narrow necks of land, particularly isthmus's, may, in process of time, gradually cut them through. The identity of the rocks, and of the strata at the same elevation of opposite continents and islands, would warrant the conclusion, that this has been the case in many instances.

But, we have now been long enough in the bowels of the earth, and the chambers of the deep; among the damps and the steams of those lower regions: let us now ascend and air ourselves in more elevated regions, where we shall have a more free and a more expanded horizon, and where quite another face of things will present itself to our observation. From what we have already had before us, in proof, there must have been an universal deluge; that is, this earth must, at some very distant period of time, have been covered by the waters; and subse-

quently have emerged, in consequence of some tremendous revolution in the external situation of the globe. From the aquatic formation of the Cordelliers and Alps, as well as from the indisputable marine productions, which are to be traced nearly to their summits, it is clear, that the level of the sea must have been more elevated than their heads; and that a land still more elevated must have existed, whose shores were of course to serve as the necessary ramparts to the antediluvian ocean. On no other principle that I know of, can it be argued, that granite is alone capable of being formed in the waters. Nor to give those waters an Alpine elevation, can it be otherwise supposed than that ancient continents must have confined them in channels, as circumscribed as ours are perhaps at this present moment. Thus, then, there was a deluge; but, not a deluge of this earth: it was of another world. But, where had these continents their existence?—I answer, in the Atlantic, and in the Pacific oceans. Do not many head lands, shoals, islands, speak most intelligibly to us, and say, we are but remnants of lands, rudely torn from other shores? And is it not credible, that some points of the primitive mountains are yet to be traced? An island of extent, or a continent lost in a spot, afterwards

occupied

occupied by the sea, is a principal fact which phænomena demonstratively attests, and from which lesser ones must naturally result. For instance, that island, or that continent, may have left some vestiges: for it would be too much, perhaps, to suppose that a prodigious land should so sink, as that no one of its prominent features should rest above the waters. What are we then to think of the Azores, the Western, and the Canary islands; and what are we to conjecture of those insulated clusters discovered in the southern hemisphere?

In the Life of Solon we are told, that while he was studying in Egypt, he was informed by the priests of Saïs, of an island, which answers to what has been since denominated the Atlantic Isle. * The story went (fabulous, or poetical, as you will), that the inhabitants of these isles became so powerful by sea, as to reduce Africa and Greece: that this celebrated island was placed beyond the pillars of Hercules, in the Atlantic ocean; and that its warriors, 9000 years before Solon, lorded it over Lybia, as far as Egypt, as well as over Greece. The island was represented to Solon to be larger than Europe and Asia; and because it was known that no

* Plutarch,

no island of such extent then existed, they affirmed, that in an after period it suddenly disappeared. Plato, a descendant from Solon, resumed this subject. Bacon, in his New Atlantis, deems the whole relation to be founded on facts. Newton, in his Chronology, has taken some pains to elucidate the account. He fixes the time of these exploits 400 years earlier, indeed; but, remarks that the Egyptian priests magnified the time so far, that instead of 400 they made it 9000 years. Other writers likewise acknowledge them, but give them another æra. The Ionim are sometimes spoken of, under the name of Atlantians; who were the descendants of Atlas, the great astronomer and general benefactor. * He was supposed by some to have been a king in Arcadia; also to have resided in Phrygia. But, the more common opinion was, that he was an ancient prince of Mauritania upon the borders of the ocean. Diodorus says, the Atlantides gave birth to a most noble race, some of whom were founders of nations, and others the builders of cities: insomuch, that most of the more ancient heroes, not only of those abroad who were deemed Barbari, but, even the Helladians claimed their ancestry from them. But, Homer, six ages

* Bryant.

ages before Plato, the reputed creator of this supposed fabulous island, speaks of the Atlantides, and of their country. The name of this people was unquestionably spread abroad: nor was any thing handed down with more appearance of truth than the position of the island,—just without the pillars of Hercules, and so near, that a few days only were required for the passage from the continent.

The traditionary story of the Atlantides, may, it is certain, be disputed. But, there are strongly marked testimonials on the face of nature, which may nevertheless give it credence. Modern discoveries seem to confirm ancient belief. America, in great measure, answers to the Atlantic continent. Nor can we conceive how the tradition of it could have been derived to the Egyptians, had there not existed some sort of historical knowledge of it. We must not concede to the ancients, however we may honour them, the gift of prophecy. And, as I have already noticed, do not the Canaries, Azores, Teneriffe, and others, (and here for the present I shall adopt volcanic mountains) manifest themselves as merely fragments of a shattered land? And may it not, therefore, be concluded, that they and their common parent were

were as well known, and perhaps more easily visited, than they are at present? But, you will tell me, perhaps, that America, instead of an old, is a new created continent.* This I cannot admit: America must have had a date, if any difference in date did exist, anterior to the continent of Europe. The waters which would have covered the Pyrenees, could not have reached more than to the foot of Chimborazo. The valley of Quito exceeds in elevation the summit of Carrigou. The southern hemisphere, together with the innumerable islands which stretch all the way round to Kamtschatka, and which have every appearance of having been a continuation of the same chain of mountains, may likewise be mentioned, but I shall for the present wave the application of them. The Atlantis of Plato we have at home at our very doors: for, as Buffon says, it was probably that land which united Ireland, and consequently North Britain, (for Britain and Ireland were probably one and the same) to the Azores, and the Azores to the continent of America: for in Ireland, says he, there are the same fossils, the same shells, and the same sea bodies, as are found in America; and some of them are not to be found in any other part of the world.

Whatever

* Buffon.

Whatever might have been the cause of the destruction of the Atlantic island, (for island or continent there must have been) fire probably had the greatest share in it. Nor need we go farther than the Giant's Causeway, in Ireland, for the traces of a disaster, which, if not the cause itself, may safely be considered as of a kindred nature. No crater, it is true, is to be discovered at the Giants' Causeway: but, it is very readily to be conceived, that the crater, even of the Giants' Causeway, together with an immense tract of land towards the north of that country, have been absolutely swallowed up. * There is, indeed, no record of it, save that of the book of nature; I mean, those stupendous cliffs which verge on the Atlantic. But, there is collateral evidence in the subterraneous fires, which have frequently burst open the bottom of that ocean. The whole coast of the northern point of Ireland has undergone considerable changes, in the course of successive ages; and it is therefore to be inferred, that the abrupt volcanic promontories it exhibits, have been rendered broken and irregular by some violent convulsion of nature; and that the island of Raghery, standing, as it were, in the midst between it and the Scottish coast, may be the surviving

* Whitehurst.

viving fragment of a large tract of country, which at some period of time has been buried in the deep.* This is not repugnant to the operations of nature: neither would the destruction of the island, as given to us in the Timæus of Plato, be less conformable to her desolating energies. Upon the whole, then, I think we may on very tenable grounds conclude, that as the sea covered the Alps, and the still higher granite mountains of the Southern America, so must there have been islands or continents to have kept that sea within its boundaries, of considerably greater elevation than the Cordelliers: and that consequently those countries must have been peopled; and the inhabitants have been comparatively to us an antediluvian people.

When the arches, or the crowns of the mighty caverns, which supported these lands, and the bodies of the waters gave way, then the present earth shewed itself, for then the ocean left it bare. Of the part left we can venture to dwell upon: of the part gone, we cannot even repeat with the poet,

* Mr. Hamilton.

« Si

" Si quæras Helicen & Burin, Achæidas urbes,
" Invenies sub aquis: & adhuc ostendere nautæ
" Inclinata solent cum mœnibus oppida Mersis." *

But, besides the Greek and the Egyptian story that we have to look to, we have an analogical aid in language, which, if not convincing, must be considered as of some authority. In the Irish, or, as we shall have reason to prove more clearly hereafter, the Scythiac language, Du Caledoni, or Dur Caledoni, expresses the flood or the waters of Caledonia, or the Scotch sea. Hence Bertius, in his Breviarium, speaks, as of an incontrovertible truth, that Deu Caledonia, or the flood said to have been in Thessaly, should have been placed in the Scotch or Irish sea. And Varenius decidedly declares, " Verisimilius est, Septentrionalis Americæ partem olim adhesisse Hiberniæ;" nor was he chimerical, or even unreasonable in the conjecture; for within these few years a bank of sand, and at no considerable depth, has been discovered, which extends from the west of Ireland to the banks of Newfoundland.†

Here, however, it may reasonably be demanded, how it was possible for men to exist in regions so very elevated as the ancient continents

* Ovid. † Collectanea de Reb. Hib.

nents must have been, whose very lowest shores must have been considerably higher than the Alps or Cordelliers, the summits of which are covered with eternal snow? To this I answer, that at first sight, indeed, it may appear somewhat difficult to reconcile the almost insupportable cold of Mont Blanc with the genial warmth which is essentially necessary to the existence, and to the permanency of animated and vegetable nature; especially, as every habitable latitude must enjoy a heat of 60 degrees, at least for two months in the year, such appearing absolutely necessary for the growth and maturity of corn. * For instance, in the highest of our present latitudes we often meet with a heat of 75 and 80 degrees. In latitudes 59 and 60, the heat of July is frequently greater than in latitude 51. But cold, you must remember, is not the attendant on a general elevation, it is simply the result of an insulated, or a partial one. The diaphanous state of the atmosphere, arising from the distance from the common surface; the greater aerial expansion; together with the absence of the reflected beams of the sun, which are powerful only as they are near to the earth and to the waters,—these are all causes of the prevalence of cold on the summits of

* Kirwan.

of mountains. But, a continent of a greater elevation than the Andes, with an atmosphere as dense as that by which we are surrounded at present, and operated upon by the solar influence, such continent would be as genial in its warmth as we can be; nor would it vary in climate, but from the same causes which with us induce an atmospherical variation. Acknowledging the sun to be the source of light and heat, what mighty consequence can we conceive the general elevation or depression of a few thousand feet? In the many millions of miles, by which the earth is separated from the sun, can the height of such an insignificant excrescence as that of a mountain, and given to a whole land, be considered as of any moment? But, we have treated this subject in a former letter, and therefore recapitulation is unnecessary.

The convexity of certain countries of this present earth is remarkable. Ancient Scythia is not, on its plains, inferior to the utmost altitude of the Alps; nor is its temperature injured by its elevation: the lands are fruitful, and the climate is favourable. Thus, according to the common course of nature, many of these phænomena are to be accounted for; nor

is there any necessity for us to have recourse to any other train of reasoning, than that which arises from objects which lie before us. Man, it is true, is calculated to live in all extremes of climate; but, we have no occasion to wrest hypothetical conjecture from such concession; nor are we to suppose that Providence formed the frames of our antediluvian fathers with a greater aptitude to the bearing of what we call inclemency; or that the atmosphere of the former world was different in any essential degree from that of the present. The depression of the barometer on the vast plains inhabited by the Mongul Tartars, ascertains the great convexity of that surface. * And, according to other observations, † the environs of Moscow, as well as the extensive countries to the north of it, are of very considerable elevation. Africa, and America, may also furnish the same features.

But you will tell me, that the constitution of the atmosphere in the postdiluvian world, might have undergone an equal change, with the different inequalities on the superficial parts of the earth; that the former earth was without elevations; and since mountains were not pri-

* M. Gmelin. † M. Paw.

primary productions, that we may reasonably suppose the inclemencies of the seasons to have been totally unknown in the antediluvian state of nature; and consequently, that thence might have resulted the longevity of the human race.* Or departing from the heterogeneous mixture of this philosophy, you may, on the vitrescent principles of Buffon, say, Why did the first races live to 900, 930, 969 years? The reason, Buffon will inform you, is, that the productions of the earth were then of a different nature: that the surface of the globe in the first ages of the world was less solid and compact; because, gravity having acted for a short time only, terrestrial bodies had not acquired their present density and consistence: that its productions were of course more ductile, and capable of extension: that their growth, therefore, and even the growth of the human body, required a longer time to be completed: and that the duration of life must be at all times in proportion to the time of its growth.

This subject of the age of the patriarchs has occasioned variety of opinions: one, that the patriarchal year was one of our months, agreeably, as it is said, to an old Egyptian practice:

* Whitehurst.

another, that three of our months made one of their years; and a third, that ten of their years were no longer than a single one of ours. These are all too vague as relative to patriarchal longevity: for if the first be admitted, the present race of men must live longer than the patriarchs: thus Methuselah at 969, could not have been more than four-score years and nine months. As to the second, it is an arbitrary supposition. And the third is more than ridiculous, for it makes men capable of generating their species at seven years of age: Henoch, when he begat Methuselah, could not have been more than six and an half. Moses, indeed, does not say that he uses solar years; and from several collateral arguments it may be clearly collected, that he does not use lunar. * As first, because he distinguishes months and years in the history of the deluge, and of the life of Noah: as, "in the six hundredth year of Noah's life, in the second month," &c. It cannot be imagined, that in the same verse and sentence, these two terms of year and month should be so confounded as to signify the same thing. Secondly, If lunar years were understood, the interval betwixt the creation and the deluge would be too short, and in many respects incongruous:

* Burnet.

congruous: there would be but 1656 months, which make but 127 years and 5 months for that interval. The number of people would have been but inconsiderable, not ten generations, which we find from Adam to the flood. Moreover, by this sort of computation, Nahor must have begot Terah, Abraham's father, when he was but two years and three months old. Even Abraham himself, who is said to have died "in a good old age, and full of years," could not have been more than fourteen years old.

The longevity of the patriarchs, is a point very generally admitted: and we have the suffrages of many of the profane writers of antiquity, as well as those of Moses, and their common consent, that in the first ages of the world, men lived an extraordinary number of years. Josephus tells us, that the historians of most nations, Greeks as well as Romans, give the same account. Manetho, who wrote the story of the Egyptians; Berosus, who wrote the Chaldean history; and those authors who have given us an account of the Phœnician antiquities; besides Molus, and Hestiæus, and Hieronimus, the Egyptian. Now we cannot suppose that all these historians, with an endless catalogue

besides, conspired together to make and propagate a fable; or that they meant lunar years. Yet, it must be confessed, the longevity of the antediluvians is very inconsistent with the present state of the earth. It is marvellous, that their fabrics of human mould should have stood eight or nine hundred years and upwards; and that those we build of the hardest stone and marble, shall scarcely last so long. Among natural causes, some have imputed this to the sobriety and simplicity of living. This might possibly have some effect: but, not to that degree we speak of. There are many monastical persons, who live abstemiously all their lives, and yet they think an hundred years a very great age. We are, as it should seem, then, like some excellent fruit when transplanted into a worse soil and climate; which degenerates continually, till it comes to such a degree of meanness as suits with the air and soil into which it has been transferred, and there it stands. Since the deluge we have continued immoveable, and without any further diminution. But, the wonder is not why the antediluvians lived so long: it lies rather on our side, why we live for so short a time? For, seeing our bodies are such machines as have a faculty of nourishing themselves, that is, of repairing their lost or decay-

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ed parts, so long as they have good nourishment to make use of, why should they not continue in good plight, and always the same, as a flame does so long as it is supplied with fuel? The one question is as difficult to be answered as the other. *

From these considerations, if the subject be not altogether taken as figurative, we must from necessity, I fear, look upon ourselves as exotic plants, which, however they might have flourished in their native soil, when removed into a different clime, are bereft of their most essential virtues: at the same time, that they grow, flower, ripen their seeds, and propagate their species. Even the several parts of any one continent, are able to alter the quality of the same plant, while it yet grows naturally in them. Nor is this effect from the difference of climate confined, as is supposed, to the vegetable creation: the animal kingdom shares it: the various tribe of reptiles, and of savage quadrupeds, increase in size and ferocity as we approach to the hotter regions of the earth. But, in truth and in fair reasoning, I apprehend we should regard the longevity of the patriarchs, as an exaggeration arising from the Oriental manner of

* Burnet.

expression. The instances we have already adduced, warrant us in the opinion. Moreover, their miraculous age even admitted, how are we to reconcile the mighty increase of the people in the East, after the deluge had desolated the earth, and had reduced us to our present standard of existence? The army of Ninus, according to Herodotus, consisted of one million, seven hundred thousand foot, two hundred thousand horse, and ten thousand chariots with scythes. Ninus lived only 250 years after the deluge. * And yet, it singularly came to pass, that the Assyrian empire one hundred years afterwards should have fallen into such a state of imbecility, as with its confederates not to be able to resist Abraham and his three hundred men. What became of all these horse, and all these foot?

The old world, as we have remarked above, must have been situated in the Atlantic and in the Pacific oceans. The traces that are left to us, indeed, are few. Plato, Aristotle, Theophrastus, Seneca, and many before their days, spoke of the existence of the Atlantic island; and even of the continent situated beyond the island. But the country of America, and the islands

* Eusebius.

islands of the South seas, you will say, do not exhibit any striking marks of former culture or civilization. This is in a great degree true. But, we are informed, and that too on respectable authority, that two wells have been discovered in North America, walled round with brick, according to the European method; a method totally unknown to the native Indians, who were in every respect unacquainted with brick: that a plough has been found sixty feet under ground, on sinking for a spring of water: that at Mistick, about four miles from Boston, many coins have been found beneath a very large stone, but with legends in a character not to be decyphered by the antiquaries of Europe. * Now, may not these instances be considered as proofs, that arts and civilization had made some progress in North America, at some very remote period of time? M. Kalm says, that in going from Canada towards the South Sea, some French travellers from Montreal, met with many fields covered with furrows, as if they had been ploughed and sown formerly. Now, says he, the nations which at present inhabit North America could not have cultivated the land in this manner, because they never made use of horses, oxen, or ploughs, or any instru-

* Whitehurst.

instruments of husbandry, before the Europeans arrived among them. These same French travellers met with a pillar, in which was fixed a small stone, covered on both sides with unknown characters, which is now in the cabinet of the king of France. Several curious remains of an ancient date, have lately also been discovered in different parts of the continent of North America. In the neighbourhood of Lexington, says Mr. Filson, are the remains of two ancient fortifications, furnished with ditches and bastions. One of them contains about six acres of land, and the other about three. Upon the banks of the Muskingum, about one mile above the junction of that river with the Ohio, and one hundred and sixty miles below Fort Pitt, are remarkable remains. They consist of a number of walls, and other elevations; of ditches, &c. occupying a considerable extent of ground. The walls are about ten feet in height, twenty in breadth, at the base, but narrower at the top. So late as the year 1751, a stone wall, between four and five feet thick, was discovered by some labourers, eight or ten feet under ground, in the neighbourhood of New York. But, all these things were common in South America, as we shall hereafter have occasion to see. One very remarkable monument, however, in South America,

rica, and the notice of which I must anticipate, is the pyramid of Cholula, said by Clavigero, who ascended it in 1744, to be at least five hundred feet in height.

M. Gebelin, in his Monde Primitif, in considering the inscription on the rock in Taunton river, in Naraganset bay, * was very much inclined to ascribe it either to the Phœnicians or the Carthaginians. But, whatever it be, it is evidently an inscription free from hieroglyphics.† For my part, says colonel Vallancey, I must confess myself of opinion, that this monument or inscription, was the work of a race of people, who arrived on this great continent prior to the present race of Indian savages. Letters or characters did once flourish amongst this people, as is instanced in the inscription made by a priestess of Michmac. Indians, in presence of Judge Spry and his sister at Halifax, copied in the minutes of the Antiquary Society, 20th November, 1766. The people who then came to this continent may, I apprehend, continues the colonel, have been the old Scythians of Armenia, who extended themselves eastward to Thibet, and north-westward to Siberia; and may have crossed from Kamtschatka to America: and

* Archæologia. vol. 8. † Vallancey.

and the late discoveries in these parts have confirmed my opinion. The inscriptions met with in Siberia bear so striking a resemblance to that of New England, that there can be little doubt of their being written by the same people. They are, in like manner, written on perpendicular rocks, forming the banks of rivers, a strong instance, by the way, of their having been navigators. A corroboration of this opinion is also to be found in Wafer's description of the Isthmus of Darien. That voyager, who was a North Briton, declares he found a striking affinity between the Darien Indian language, and the Highland language, which is originally Sythiac.* The following he gives as a specimen.

Darien.		Ancient Scotch.
Tatah	Father	Tat
Nanah	Mother	Nainn
Punah	Woman	Bun
Rupah	Brother	Rubhag
Da	Is	Ta
Ma	My	Mo
Nee	The Moon	Nei
Neenah	A Girl	Neenae
Eetsha	Ugly	Etisha
Pa	An interrogation	Pa
Capa	A hammock or covering	Caba

That

* Antiq. Brit. and Ire.

That islands and continents derive information from accident, as well as from design, is evident. Captain Cooke says, that Omai happening to go on shore on the newly discovered island of Wateeoo, was surprized at seeing among the crowd assembled on the shore, three of his own countrymen, natives of the Society Islands. The distance between these places is at least two hundred leagues, across an unknown ocean. About twenty persons, male and female, were in the canoe, that was thus driven by a storm to a new shore: most of them perished by famine. Captain Cooke quotes, also, two similar relations: * one, that in 1696, two canoes, having on board thirty persons of both sexes, were driven on the isle of Samal, one of the Philippines, having performed a voyage from an island called Amorset, three hundred leagues to the eastward. The other, that two canoes, one containing twenty-four, and the other six persons, men, women, and children, were driven, after a voyage of twenty days, on one of the Ladrone islands. From misfortunes similar to this, indeed, and before Columbus's time, or that there was any settled navigation to America, an hypothesis analogically founded might be allowed: for if the other three parts of the world could have been so amply

* Lettres Edif. and Cur.

ply stocked from the progeny of but two persons, in less than four thousand years, why might not the other fourth part have received its population, if such were necessary to it, from the casual straying of one or two vessels in the earlier ages of the world? But, this we will not too strenuously insist upon, although M. Buache boldly asserts, that New Greenland was known before it was discovered by the Danes; that America was known, (and here he is supported by a long chain of respectable evidence) and even inhabited by Europeans before the arrival of Columbus there; and that the history of the colonies, which are said to have gone thither from Wales in the year 1170, under the guidance of Madog, one of the sons of Owen Gwynedd, the king of that country, has a decided foundation in fact. *

The vicissitudes of nature, during the succession of ages, have made it probable, that the same history may have been appropriated to different personages; or that the same accidents may have rendered a discrimination of facts difficult, if not impossible. Hence, that which was said to have been done by Cronus and Astarte, the Greeks attributed to their Themis and

* Mem de L'Acad. Roy. des Sci. 1784.

and Apollo. The like account was also given of Ouranus, the great king of the Atlantians.* Colonies, also, and even accidental populations have generally gone out under the patronage of some divinity: and the conducting god has, in after times, been supposed to have been the real leader: whence supernatural and figurative tradition. But, if instead of a person, we put a people, we shall in general be right: for, to go no farther, the many and great atchievements attributed to heroes of the first ages, it was not possible for any one of them, singly, to have performed. Nor is it easily to be imagined, if our earth was as it has been ever since the tremendous stroke which annihilated the former state of things, and which broke it into continents and islands, how mankind could have been propagated at first through the face of the earth, all from one head, and from one place: for navigation, we are taught to believe, was not known, at least as to the main ocean, or to pass from continent to continent: and further, that Noah's ark was the first ship, or vessel of bulk, that was ever built in the world.† How, then, in the common course of human events, could the posterity of Adam overflow the earth, and stock the

* Bryant. † Burnet.

the several parts of the world, if they had been distant, or separate then, as they are now, from the interposition of the great body of waters? Or, to go at once to the origin of all this allegorical doctrine, has any one tolerable reason ever been offered, why the Deity, for the transgression of man, should curse and destroy the whole terrene animal creation, and that he should let all the fishes and watery members escape, as a mark of especial grace and favour?

In the developement of our subject, and which it is for the present, time for us to draw to a conclusion, we have had many intricacies to combat with; but I trust, we have neither used a profane, or a licentious freedom. Truth has demanded boldness, nor could the investigation have been pursued without it. To ascertain demonstratively phænomena buried in the obscurity of ages, is beyond the reach of common ability. Deduction, therefore, was all that I had left;—but that deduction I have drawn from what appeared at least clear and reasonable, if not founded on self-evident principles. There are times, says Fontenelle, when I fancy myself suspended in the air, and where I continue stationary, while the earth turns round under me

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in four and twenty hours. I see pass before me varieties of faces, white, black, swarthy, olive. Now it is a people with hats; anon with turbans. Here a set with long hair; there a set closely shaved. Now cities with steeples and crosses; now with pagodas and temples. Here an extensive country covered with cabans; there seas loaded with ships: there frightful desarts. In short, all the endless vanity which is on the surface of the earth." In such imaginary mode, while the face of nature so amply warrants the supposition, why may not we figure to ourselves a lost people who were scattered on ancient continents, and who embellished those continents by their varieties? That which is, assuredly might have been. The power of God is infinite. To some fastidious minds it may appear that we intrench a little too far upon the traditions given to us in Scripture; but, I beg of them not to be too hasty, nor to condemn intemperately, an effort purely meant as an elucidation of what in itself may have been grounded on fact, but what, in its ordinary explanation, is made irreconcilable to reason and to common sense. The deluge of Noah, as we have already seen, taken even from the very words of Moses, cannot be considered literally as an universal one. It must

have been local and confined. The disaster, however, from which our first parents may seem to have been preserved, might have been more general. Then, indeed, it is possible to conceive, that the whole, or a part of the ancient world might have been covered by the waters; and when the present earth emerged from the bosom of the ocean, that then our unhappy progenitors might have found a different face of things from that which they had experienced in their Paradise; and that the lonely world might in barrenness have lain before them, as they took their solitary way, where to choose their place of rest, yet with Providence their guide. But, even on this I dare not insist too much. On very strong evidence it has appeared, that others of the human race, besides his own family, existed in the days of Adam: and that even the emblems, which are allegorically given to us by Moses of the first state, were probably derived from another people. On this subject we shall hereafter have occasion to be more critically minute. Till then, therefore, we shall defer a more particular discussion of it. All we shall now say is, that though we can trace back our progenitors footsteps to a distant antiquity, farther, indeed, than any fragments or positive

positive remains of record, we yet cannot, in imagination even, draw aside the curtain, and fancy the openings of the wonderful scene of a first existence.

LETTER XLVIII.

BUT what is there in this diminutive earth which should surprize us? Let us turn our eyes a little farther: there, indeed, we shall find matter for sublime and awful contemplation. Nature is not a limited, it is an unbounded machine, in which the race of man forms but an inconsiderable wheel. All beings, all operations which originate with her, must be good, must be noble and interesting: they all must tend to one point,—the production of harmony and order. The strongly-marked characters, which the earth in every place presents to us, speak in a language which cannot but arouse the most torpid understanding. But, that which is above us is more legibly distinct. The firmament is the elder Scripture, written by God's own hand: an undisputed, an universal Scripture. Portions of this globe have disappeared, but, whole systems have been extinguished in the heavens. How do objects, which we call vast, vanish in comparison with the ætherial worlds, which roll

roll in space. The terraqueous ball becomes lost in the solar system; the solar system in the immeasurable expanse of the universe; and the universe itself, in its Almighty Creator.

Among the Alps, where you now wander, and elevated, as I trust you now and then are, into a purer atmosphere, you can with peculiar advantage raise your speculations towards the higher spheres, as well as to the earth: to the planetary, as well as to the terrestrial existence. Surrounded in general by a mass of dense and heavy air, whose particles reflect other rays of light to our eyes, than those which come directly from the sun, we cannot discern the heavens in the manner they must appear to you. At mid-day we are encircled by an undistinguishing body of light; but at mid-day the heavenly concave with you is dark; and with you, the stars at noon are visible. "When on the top of Mont Blanc," says M. de Saussure, "the moon shone with the brightest splendour, in the midst of a sky as black as ebony; and Jupiter, rayed like the sun, rose from behind the mountains in the east; while the dazzling white of the snow formed a contrast as delightful as it was singular." What beautiful, what unexampled scenery! "Straying up the sides of the hoary

mountain," says he, "the stars, as if the veil of heaven were withdrawn, burst upon our sight: the dingy vault, in whose profundity we were lost, was seen bespangled with glowing worlds. The host of stars were found to spread in the brilliant fields of æther; and their numbers to be more increased than the sparkling drops of dew on the surface of our vales. These moving orbs were unequally distant from us. Some were many millions of times nearer to us than others; and yet they all appeared to be at an equal distance. The sun we know to be nearer than any of the stars. The moon, and some of the planets, are known, by ocular proof, to be nearer to us than the sun, because they sometimes come between it and our eyes. Still they all appeared placed in the surface of a sphere, of which our eye was the central point." Nor would this be otherwise, were we even in the regions of Saturn. Wherever we can fancy ourselves to be placed, there we should seem to be in the centrical point of the universe. *

The view of nature, which is the immediate object of sense, is imperfect, and of small extent; but, by the assistance of art, and the aid of reason, becomes enlarged, till it loses itself in

* Adams.

in infinity. As magnitude of every sort, abstractedly considered, is capable of being increased to infinity, and is also capable of indefinite indivisibility, so we find that in nature, the limits of the greatest and the least dimensions of things are actually placed at an immense distance from each other. We can perceive no bounds of the vast expanse in which natural causes operate; and fix no limit or termination to the universe. Our sun propagates his rays to enlighten us: other suns kindle to illuminate other systems, where our sun's rays are unperceived: and they, in their turn, are lost in systems still more remote. When we have risen so high, as to leave all definite measures far behind us, we find ourselves no nearer to a term or a limit. * What a magnificent view of the creation does the contemplation of the heavens afford us! By roaming thus abroad into the universe, we exalt our ideas of the Supreme Intelligence, and extend the narrow sphere of human conceptions. The understanding, in the pursuit, becomes enlarged; the faculties become strengthened and improved; and the mind irresistibly finds itself elevated to that great Being who informs, directs, and animates the whole. The science which conducts us to certainty in

* Maclaurin.

these ætherial speculations, was known to the earliest people of whom we have any records, Whence did they derive their information? To this we shall probably be able to reply hereafter.

In the variety of situations in which man is to be placed, I know not one so much to be desired as that, where breathing a pure and serene air, and where a rarity of medium, giving a resplendency to the luminous orbs of heaven, immediate and irrefragable proofs of the Divinity become manifested to his senses. In addition to the admiration occasioned by their magnitude, how clearly does he perceive that the same hand that launched those mighty spheres, at the same time marked out their destined road, and left not even the hazard of their encountering! Where, then, is the comparison between the preservation of such bodies, and that of a feeble race of beings, who continue their species from year to year, and then in their material parts fall into dissolution? The wildest imagination cannot surely suppose, that this great sytem was solely made for the sake of man; or that this little planet, where we sojourn for a few days, is the only habitable, or inhabited part of the universe. How extravagant the idea,

idea, that we, who come into the world at the pleasure of others, and who go out of it by an hundred accidents; who by birth and education, neither of which is in our own power, are generally determined in our fates; whose understandings are as uncertain as our fortunes; whom a blow on the seat of sense may render less rational than the beasts of the field; that we, who can be taught to believe every contradiction and absurdity, should be the super-eminent creatures, upon whom all things of the universe wait, to whom all things are subservient. *

The objects of philosophical enquiry are so diversified, that in astronomy, as well as in natural philosophy, though we cannot positively affirm every thing we say to be fact and truth, yet in so noble and sublime a study as that of nature, it is glorious even to arrive at probability. The earth, our known habitation, notwithstanding its many wonderful productions, is yet, when compared with other bodies of our system, a mass of very inconsiderable dimensions. Instead of being singular, with respect to inhabitants, it is probably only one, out of a multiplicity of worlds, variously dispersed. Hence it has been calculated, that to pass from one star to another,

* Burnet.

another, and to visit any one of the neighbouring systems, even as fast as the swiftest eagle could fly; for instance, five hundred miles per day, it would take three millions of years for the performance of the journey; and if continuing on to view the regions of the rest of the systems within the known creation, that myriads of ages would be spent, and yet the whole of the smallest constellation would not be thoroughly investigated.* Of these habitable worlds, all of which may be supposed of a terrestrial, and of a terraqueous nature, and filled with beings of an animated species, the numbers are not to be ascertained. One hundred and seventy millions have been supposed by certain philosophers; but this, it is reasonably to be apprehended, falls far short of the truth. What is the catastrophe of a world, therefore, such as ours, or even the total dissolution of a world of systems? In comparison with the great celestial creation, it may not possibly be more to the Almighty Author of existence, than the burst of an evening meteor: nor can we otherwise conjecture, than that such final and general extinctions may be as frequent there, as even birth days, or mortalities, may be with us.

The

* Wright.

The sun, from whom our immediate system derives its light and vegetative qualities, is about 1,392,500 times of greater dimensions than the earth. It is even reckoned to be about 539½ times larger than all the planets put together. * Its distance from the earth is about 95,173,000 miles, and from Saturn 907,956,130 miles: and the velocity with which we go round it, may be estimated at nearly one thousand miles in a minute. This is immense, and renders comparative distance and velocity, as we experience them, as points of insignificant consideration. And since the nature of our sun is not different from that of the rest of the stars, the nearest of which, Sirius, or the Dog-star, is not perceptibly altered in magnitude, though at one point of our orbit we are 190 millions of miles nearer to it than at the opposite, we cannot, without a dereliction of all reason, imagine him to be the general center of the whole creation. The sun, therefore, all glorious as it is, is no longer to be considered as possessing the super-eminent place in the incomprehensible scheme of the universe, which formerly was given to it. All great astronomers, Newton at their head, have maintained that the stars are all suns, and surrounded with planetary bodies. The celebrated Huygens says, "Why should we

* Adams.

we conclude that our star has better attendance than others? They must all have their plants and animals: nay, their rational creatures too." "Could we," observes a learned writer, "wing our way to the highest apparent star, we should there see other skies expanded; other systems established in unknown profusion, through the boundless dimensions of space." Where things cannot admit of mathematical certainty, moral certainty ought to be indulged: the analogy of known and natural things. It scarcely can be reckoned more irrational, to suppose animals with eyes destined to live in eternal darkness, or without eyes to live in perpetual day, than to imagine space illuminated, where there is nothing to be acted upon. The fixed stars were not created barely to enlighten a void. The universe is crowded with myriads of glorious worlds, and which, from an atom to a creation indefinite, animates and fills the endless orbs of immensity. Herschel, in passing over the heavens with his new telescope, observed in the space of a few degrees, 44,000 stars. This would seem to indicate that there were seventy-five millions in the heavens.* But, what are these, when compared to those that fill the boundless fields of æther?

As

* M. de la Lande.

As I have above observed, in lifting our eyes to the firmament, we see all the stars, as it were, attached to the same dome. But, this is merely an optical illusion. They are, in truth, at prodigious distances from each other: and as relative to us, the nearest fixed star is five hundred thousand times a greater distance from us than from the sun. * All objects within the sensible sphere of the sun's attraction, or activity, are in some measure magnified by a telescope; but, the fixed stars are placed so far without it, that the best glasses have no other effect, than the making them more vivid in their appearance: and hence a proof of their integral capacities: for all innate opaque bodies, reflecting only a borrowed light, are all observed to lose their light, in the same proportion as they are magnified; and through all glasses, to appear more dull than to the naked eye. Light passes at the rate of more than 100,000 miles in a second. But, on the subject of light, we, on a former occasion, experienced the necessity of being somewhat more than hypothetical; although the doctrine of its proceeding from the sun was strongly, though not convincingly, opposed: nor shall we here revive the question, notwithstanding Franklin, in certain queries, not, indeed, in

* Lambert.

in positive assertions, has seemed to lean to the same side of the question: for instance, he supposes universal space to be filled with a subtile elastic fluid, which, when at rest, is not visible; but, whose vibrations affect that fine sense in the eye, as those of the air do the grosser organs of the ear. "Thus, in the case of sound," says he, "it is not supposed that any sonorous particles are thrown off, from a bell for instance, and fly in straight lines to the ear: why, then, should we believe that luminous particles leave the sun, and proceed to the eye?" But, all this, I think, on reference to what we have already investigated, you will find fully explained. And, in addition, our present inquiry into the general phænomena of the planetary systems, especially of our own, will further convince us, that light is derived immediately from the sun: we have a proof of this; for example, in the moon, who possessing no inherent light herself, does not display the same splendour; but, in her disk assumes a different form, as she approaches or recedes from the fountain of her illumination.

The earth was long considered as a large circular plane, spreading out on all sides to an infinite distance: and the heavens above it, in which the sun, moon, and stars appeared daily

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to move from east to west, were imagined to be at no great distance, and to have been erected solely for its use and ornament. And of this opinion are the vulgar, and those who are ignorant of astronomy, even to this day. But, observation and experience have taught ingenious men better. Yet, it is natural to inquire, how this earth, spherical as it is, and unpropped in the apparently unresisting regions of space, is so permanently supported? Newton tells us, it is by gravity. The whole, and every part of this globe tends, says he, towards its own immediate center. To that center, from every atom in the wide circumference of the earth, there is supposed a descent, in various celerities. Beyond that point of concentration none pass: there they stop. Hence all particles and substances, acting and counteracting, preserve the equilibrium. In its own inherent energy, therefore, it finds its form; and in the solar and attractive influence, it finds its stability. The same atmosphere, and the same powers surround the globe. As the antipodes are opposed in situation to us, and yet are upright and firm; so is the opposition, we may say, and the uprightness of matter established. But, to speak with more mathematical precision—towards the center of a spherical

spherical body, is always downwards, for the center must be the lowest point, with respect to the weight of any body placed upon it. There is no other universal downwards but that. Downwards and upwards change both with respect to the opposite sides of the same body, and even with respect to the different great bodies of the universe. Thus, when a ship sails round the world, it would be ridiculous to think, that universal downward turned upward. But, the absurdity of it is still more clear, if you suppose, there was a time when there was not a compacted body, even in the infinite space. In such supposition, try if you can imagine a downward or an upward. It is impossible. Downward is only as it respects the center of a spherical substance. *

It is likewise natural to demand, if the earth, and the other innumerable orbs, be balanced in the regions of space by the same laws of gravity, and by the same centrifugal and centripetal forces, what must be the enormous magnitude of that body which can govern the whole? To this no man can reply: for, who shall presume to compute the size of the Almighty cause?

* Baxter.

cause? Who shall venture to calculate the space and time which all the globes, all the worlds, all the worlds of worlds require, to move round the throne of Omnipotence, that centre of the Divinity? What painter, what poet, what imagination is there so sublime, which would hazard the description of the grandeur, the magnificence, and the beauty of that source, whence in eternal torrents flow all the harmony, and all the order of the universe? Whatever may be the inability of man, however, there may be still, I will allow, an humble conjecture drawn from analogy: and thence the creation, granted to be orbicular, it may in all reverence be supposed, that in the general centre of the whole, there resides the one intelligent principle, from whom proceeds that mystic and paternal power, productive of life, light, and the infinity of things. But, what this central body is, it is not for man to know.

The heavens are a country of great events; but the human eye is unable to perceive them. A sun which perishes, a world, or a system of worlds, which is destroyed, has no other effect upon our sight than an ignis fatuus, which gives a transitory blaze, and appears no more. Man, limited to the terrestrial atom on which he ve-

getates, views this atom as a world, and sees worlds only as atoms.* But if the universe be one great whole, and the celestial bodies act reciprocally one upon the other, it indisputably must have motion; and not only motion, but a law to embrace and regulate all those motions. The globes of our solar system, are found to gravitate towards each other; or rather the force of gravitation towards the sun, is inversely as the square of the distance; all the particles of matter attracting one another in the reciprocal duplicate ratio of their distances. Yet, whether this were so or not in demonstration, there is evidently an inherent virtue, an essential property in matter, which establishes the fact upon the most certain grounds. The law of attraction, therefore, reigns through the universe. By attraction, the order and harmony of the spheres are preserved. Yet, in regarding the starry heavens, it is said, that precision and symmetry are in vain sought for: stars of every size are intermixed. In some places, the largest seem to croud together; in other regions, the numbers are comparatively few: the milky way, that luminous arch which invests the heavens, exhibits them like drops of water in the atmosphere whence the rainbow is refracted, as almost

* Buffon.

most touching each other; and hence, their rays uniting, form that singular zone of light. Nor is this via lactea itself, by any means regular or equal; there are places where it appears shattered and broken: it is even allowable to say, that it seems detached from the rest of the heavens.*

The impulsive motion of the planets, says Buffon, gives rise to numberless phænomena, which do not admit of an explanation, by gravity alone. Other writers object, also, to the rotation of our earth, which, as we have seen above, travels at the rate of fifty eight thousand miles every hour; a rate, it must be acknowledged, 120 times swifter than that of a cannon ball, though at the same time of little more than half the velocity of Mercury. For, if the earth really do move in this manner, say they, a stone dropped from the top of a high mountain would not fall just at the bottom of it, as the mountain must have advanced considerably forward during the time of the fall: this indeed, to uninformed minds, is in some degree perplexing. But it is demonstrably a mistake; for it is well known, that if a body be projected from another body in motion, it will always partake of

* Lambert.

the motion of that other body. Thus a stone from the top of a mast of a ship, while the ship is under sail, is not left by the vessel, but falls exactly at the foot of the mast; and thus the water from a bottle suspended in a ship, will empty itself drop by drop into another bottle placed exactly underneath it, though the ship shall have run many feet whilst each drop was in the air.*

But in reply to what Buffon says, or to the idea which had taken possession of many men's minds, long before Buffon wrote, one word from Newton himself will be abundantly sufficient. "What the efficient cause of these at-"tractions is, I do not inquire. What I call at-"traction, may possibly be caused by some *im-*"*pulse*, or some other way unknown to us. I use "the word attraction, only in general, to signify "the force by which bodies tend towards each "other; whatever be the cause of that force. I "have explained the phænomena of the heavens, "by the force of gravity; but the *cause* of gra-"vity, I have not yet assigned. It is a force "arising from some cause, which reaches to the "very centres of the sun and planets, without any "diminution of its force. It reaches every way "to

* Bonnycastle.

"to immense distances, decreasing always in a "duplicate ratio of the distance." Leibnitz, also unaccountably calls this attraction a miracle, an unphilosophical term. But surely attraction is not more wonderful than animal motion; for though the means by which two bodies attract each other may be invisible and intangible, yet as they act regularly and constantly, they may fairly be called natural. Was animal motion ever called a miracle?

The motions of the universe do not derive their influence from mechanical causes, hi motus originem, non habent ex causis mechanicis.* And yet all gravity, attraction, repulsion, or whatever other tendencies to motion are observed in matter, are not powers implanted in matter, or possible to be made inherent in it: they are impulses, or forces impressed upon it *ab extra*. The *movens* and the *motum*, cannot be the same thing. For what is impetus, or force in a moving body? It is nothing but the result of the resistance in matter to change its state. In opposition to this, indeed, some philosophers have conceived, that the power of gravity may be the effect of some

* Newton.

fluid, or very subtile matter, impelling those bodies, we call heavy; and Dr. Pemberton says, that the great Newton himself conjectured it might be so. But, whatever Newton might have conceded in some points, he in most cases refused a mechanical cause to gravity. "Gravi-"ty, says he, acts not according to the super-"ficies of bodies, as mechanical causes do, "but in proportion to the quantity of their "solid matter." But in fact, the powers of gravity, attraction, or repulsion, can no more be lodged in the matter of this fluid, than in the matter of the real bodies; for it is as contradictory in respect to one sort of matter as of another; of a very small particle, as of a very large substance. Moreover, the action of a fluid upon a body, could never make it gravitate towards another.* But there is still a greater difficulty in the way of this opinion. If every particle, through the whole solidity of a heavy body, received its impulse from the particles of this fluid, it should seem that the fluid itself must be as *dense* as the very densest heavy body; or that there must be as many *impinging* particles in the one, as there are *gravitating* particles in the other, which receive their gravitation by being impinged upon. Now this is contrary to the phæ-

* s'Gravesande.

phænomena of motion in general.* On the whole then, it may be concluded, that gravitation is not caused by a material impulse; because, if it were, it would not be proportionable to the quantity of matter, or the solid contents of bodies, without any regard to their superficial proportions, as we find from experience it is; for all bodies of all textures, of all configurations of parts, and of all varieties of superficies, whether a bullet, a feather, a sheet of gold, or a sheet of paper, all descend in *vacuo* with an equal velocity.† To an immaterial cause, consequently, we must have recourse. Something, that is not matter, must of necessity be allowed to be the cause of gravity.

The Almighty fiat gave their impulse to the celestial orbs. Motion gives rise to the equilibrium of worlds, and the repose of the universe. Millions of luminous globes form the base of the glorious structure; millions of opaque globes circulate round the former, and constitute the moving order of its architecture. In an illimitable expanse, routes or orbits are established, and stations are fixed. But the clear elucidation of a primary cause, is impracticable.‡ Should it be asked, why matter is impenetrable?

* Baxter. † Clarke. ‡ Buffon.

we must either return no answer, or say, it is so, because it is so. The same with respect to gravity, extension, the inertia of matter, or any other general quality of matter. Such inquiries greatly exceed the powers of human intellect; and consequently are useless. But to a question relative to an effect, we may be capable of replying. The demand, in truth, as it regards the wonders of the creation, why a thing is so? is presumptuous. How it is so? is modest, and may be satisfactorily resolved. In multitudes of cases, the deepest philosopher is as ignorant as the inhabitant of the woods. Yet, there is a point to which he can elevate himself. There, however, he must stop; and there resting himself, must say, this or that indeed, may be—I will venture to pronounce nothing to be impossible;—all I shall say is, that I know it not. The mind of man is inadequate to the reception of all the nicer springs, and appropriate laws, of the actual world. We embrace a great deal; but to understand the whole of the scheme of the universe, would be to possess that omniscience, which we can only suppose vested in God. To the investigation of man, the book of nature is open, and it is written in an universal language. All may read it to a greater or less extent. But

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the philosophy which it holds out, although its general object be as extensive as the variety of nature, only admits of a definite improvement.

The vanity of science, sometimes leads men reprehensible lengths. As for instance, Buffon, when he says, the earth from the surface to the centre, is vitreous. The Moon of a dense substance, approaching to lime-stone; Mars, of a texture similar to marble; Venus, of that very hard ferrugenous stone, emery; Mercury, of a substance denser than tin; Jupiter, of one less dense than chalk; and Saturn, of one almost as light as pumice-stone. Is not this being as ridiculously familiar as Voltaire, who, in designing Geneva, called it, la petite République voisine de ses terres? However, I will acknowledge, it at the same time manifests the most ill regulated intellect, to impose upon credulity, and to arrogate an unfounded superiority of understanding. Much knowledge, indeed, is supposed to exist in sentences composed of occult assumptions. But where is the difference in the answer of the pupil and of his preceptor, if they be both asked, whence is it the loadstone attracts the iron; and the one answers, he does not know the reason of it; and the other says,

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it is done by some virtue or occult quality? Is not this to say the same thing in different words? Universal attraction is in like manner inscrutable. But in effects, we see it exists; and on those effects, we must establish our belief, that the Almighty so impressed it, when he launched the ætherial mansions into being.

In the infinite abyss of space, which the Greeks called *το ωαν*, and we the universe, a *plenum* or a *vacuum*, has been alternately supposed to exist. The controversies on this head are of ancient date. The plenum, signifies every part of space to be filled with matter; the vacuum, a space empty, and devoid of matter. Now, whether there be any such thing as an absolute vacuum, or an absolute plenum, is a point that probably will never be ascertained. It is argued, indeed, that motion could not be effected without a vacuum. The motions of the planets and comets, it is said, demonstrate a vacuum. And Sir Isaac Newton has ventured the opinion, "that the celestial spaces are void of all sensi-"ble resistance, and consequently of all sensible "matter. For that the motions of the planets "and comets may be regular, and lasting, it is "necessary the celestial bodies should be void "of all matter, excepting perhaps, some few

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"and much rarefied effluvia of the planets and "comets, and the passing rays of light."

An empty space cannot well be supposed to be a property, or a portion of the universe; for that which belongs to a whole, must be formed of parts: to make an infinite space, we must connect finite spaces. Moreover, we are taught to believe, that the immensity of God makes him actually present in all spaces. Space out of the world, is certainly little better than imagination. Every thing around us, capable of making an impression upon our senses, is distinguished under the general term matter. On stretching forth our hands, if a body be within our reach, we lay hold of it; if not, we receive no sensation. And this absence of matter, we learn to discover by sight, as well as by feeling. This emptiness is distinguished from bodies capable of striking our organs by the name of space, the meaning of which can only be tangible or not tangible. This is all the knowledge we can possibly obtain of a vacuum. Of this space, we can say no farther, than that it is an emptiness of matter, solid enough to impress our organs.* Yet, on the other hand, although the followers of Newton have

* Material World.

have argued the necessity of a vacuum, without which, they say, motion would be impossible in nature, because, any body moved, would every instant be obliged to displace a mass of matter always equal to his own, and would of course meet with a density of resistance, as real in a fluid mass, as in a mass of stone. Yet, the admission of a perfect plenum, would be the admission of an universal stiffness or counteraction.* But why God must have an abhorrence to a vacuum, as the Cartesians contend, is to me incomprehensible. Plenums and vacuums, finites and infinites, do excellently well indeed in the subtilety of Schoolmen; but it is a query with me, whether their reason be not as bewildered as ours is, by the discussion of the pros and the cons.

In the arguments upon this question, it has probably happened, that the zealous on both sides, have sometimes been hurried away from the orthodoxy of their first principles. The Newtonians clearly wandered from the track pointed out to them by their master; and the Cartesians, exulting in the ingenious, the amusing romance of a great mind, the *tourbillons* of their leader, forgot that a mathematical certainty

* L'Abbé Pluche.

tainty was generally the aim of his speculations. The vacuity of the multitude, is a void destitute of all matter; an arbitrary notion, contradicted by general experience. The air, whence we gain our idea of vacuity, may neither be seen nor felt; but it is well known, that no respiration could proceed without a fluid matter, gross enough to occasion the action of the lungs; neither can an absolute vacuum be made by any artificial engine. The indefinite divisibility of matter is manifest; for all bodies we know of, are composed of parts separable from each other. They may, indeed, be so divided as to elude our sight or touch; but the sphere of our senses is not the test; matter may also be rarefied without limitation. Æther, in comparison to grosser air, appears to us like a vacuity: yet, it has no more resemblance to the imaginary vacuum of the philosophers, than the compactest body. Without the vast leap therefore, from absolute fulness to absolute vacuity, may we not imagine the regions allotted to space to be filled with fluid matter? That which exists in the space between the sun and the earth, may be readily supposed to exist in the rest of the universe. All, or most of the planets, the sun itself, has an atmosphere. But the fact is, as we have above evinced, that Newton did

did not look upon space as empty; nor did he even regard it as filled with a fluid without action. On the contrary, he calculated the energy of that force, and looked upon it as 490,000,000,000 times greater than that of the air of our atmosphere.* Wherefore he called it a fluid eminently elastic, and infinitely expansible: he acknowledged it to be a fluid in which all bodies floated. His words are: "the elastic force of æther is excessively great; "it can suffice to push bodies from the densest "part of its own medium, into the rarest, "and that with all the power that we call "gravity." Newton thus admitted the impulsion of æther to be the physical cause of gravity. And hence of course, he is not to be accused of having insisted upon an absolute vacuum.

Instead of one sun and one world, therefore, which gravitate and perform their revolutions in these subtile regions of space, we see an inconceivable number of suns, and of systems of worlds; and that the point we possess, is comparatively so small, that were we, with all our planets, moons and comets, to be at once annihilated, we should scarcely leave a sensible blank

* D'Alembert.

blank in the creation. Those prodigious spheres of fire, the fixed stars, it is reasonable to conclude, are made for the same purposes that the sun is; each to bestow light, heat, and vegetation, on a certain number of inhabited planets, kept by gravitation within the sphere of their activity: what we know of our own system, leads us to this conclusion. One orb must be contrived and regulated with the like wisdom as another. What an august, what an amazing conception does this give of the works of the Creator! Thousands of thousands of suns, multiplied without end, and ranged all around us; all in rapid motion, yet calm, regular and harmonious, invariably keeping the paths prescribed to them; and these worlds, peopled with myriads of intelligent beings, formed for endless progression, in perfection and felicity! This glorious scene, which we thus are permitted to contemplate, is surely the sublimest and the most interesting in nature: and in truth it leads us, by some specious arguments at least, to form the pleasing deduction, that minds capable of such deep researches, not only derive their origin from that adorable Being who governs all, but that they are also invited to aspire after a more perfect knowledge of his nature, and a stricter conformity

formity to his will. The pure, ætherial substance, however, which may be thus imagined to envelope the various orbs of heaven, was formerly supposed to inform, unite and actuate the whole mass of matter, as of one great perfect and organical body; and it was therefore called the soul of the universe, or the *anima mundi*. But this hypothesis has been deemed untenable. God's being present, in, or to the world, does not make him the soul of the world. A soul, is part of a compound, whereof body is the other part; and they mutually affect each other, as parts of the same whole. But, Deus omnia Regit, non ut anima mundi, sed ut universorum dominus.*

Motion, it is true, is an effect in general, when we consider our own frames, produced in our bodies by our minds. Nor was it a very improbable supposition, that every motion we see produced in nature, depended upon a similar power; and that it was performed by some spirit acting upon it, and directing its effects. There was no great inconsistency in this; nor was it hostile to common sense to argue the universal influence of spirit over matter. Motion was known to arise from a spiritual substance,

* Clarke.

stance, or from something ab extra in bodies: for matter of itself, is motionless and inactive; and hence the ancient notion in philosophy, that the whole universe was actuated by a soul or mind, in the same manner as the motions of our bodies are directed by a living principle. I move a ball, it is said, at which time I am conscious to myself of no prior action upon my body, as the cause of the motion which I produce, but it appears as the mere spontaneous effort of my own will. Wherefore, when I see the sun and planets revolving, and many other actions produced, when motion is perceived, what forbids, that I should not acknowledge an invisible Being to be the immediate cause in the same manner? * The operations of the divine agency, no man will presume to call in question. Even Sir Isaac Newton himself, was not so completely satisfied with his mathematical reasonings, as to conclude that it was a primary cause. By the subtile æther, he was led to believe, the planetary motions were originally set forward. But to whatever extent the action of this ætherial fluid may be admitted; and whether it be supposed to pervade the universe, as by some it has been supposed to pervade the animal

* Farr.

body, and to cause animal motion, it never can be satisfactorily determined to be the anima mundi; or that a mass of matter can partake of a portion of the divine essence.

Placed as we are in this our little world, and standing as it were upon an atom rolling in a corner of the universe, can it readily be believed, that we should yet dare to demonstrate physically, the first elements of things; to explain the causes of heavenly phænomena; and to develope the mechanism of an incomprehensible whole? Yet such has been the temerity of human insects. As relative to our own pigmy sphere, we have already had a sufficiency of extravagance; but, as relative to the celestial bodies, the absurdities are still more amazing. "All the matter in this solar world," says a writer* (from whom Mr. Whitehurst probably borrowed his terraqueous theory) "was unformed and indigested, without life or motion. Either the matter was not broke, and attenuated into those fine corpuscles which compose light, or else they were entangled with the parts of dissimilar gross substances mixed with them, so as to make the whole expansion resemble a great dark, muddy globe. So that by its opacity, it

* Conf. with a Theist.

it prevented the light of the stars, or of any luminous body, from passing through it. In this condition the chaos stood, when the fiat for light was given. And then, when the divine spirit, or the wind of God, made its incubation on motion in the abyss, all the confused, stagnating principles of matter, began to range into form and order; the dull, heavy, terreous parts, which overclouded the expansum, had their summons to retire to their respective centres, and they presently obeyed the almighty orders. Part subsided to the Earth; part to Jupiter; part to Saturn; part to Venus; and so on, till the globes of their respective planets were completed; till the whole expansum was cleared of these gross and opaque parts of matter; and that from a muddy, darkened chaos, it became a tenuous, pellucid globe." In an equal degree of wildness, but with more imposing brilliancy, Buffon has been led to pronounce, "that the planets are pieces of the sun, "dashed violently from his surface; that when "they issued from him, they were liquid fire; "that during their fluid state, they necessarily "assumed a circular form; that their diurnal "motion elevated their equators, and flattened "their poles; and that their common direction "from west to east, and their centrifugal forces,

"proceeded from the same cause, and from the "single stroke which they received at their "creation."

These fairy and unphilosophical reveries, especially as proceeding from men of genius, at once excite surprize and regret. But as magnanimity has often been seen to run into rashness and profusion; so has invention been as often observed to slide into extravagance and wildness. Mere fancy, in investigations of a serious nature, is idle and unbecoming. The imagination that will soar, must be guided by judgment. The brave eccentricities of an original cast of mind, and the daring hardiness of native thought, are infinitely to be admired. But although we mount like eagles, between the earth and heavens, and leave behind us clouds, tempests, and all the grossness of a heavy atmosphere, it yet is forbidden us to adventure too far, or to affect a flight, to which mortal pinions are unequal. Circumscribed ideas inevitably lead to circumscribed conclusions. But though experimental philosophy has discovered many things in the order of nature, yet human knowledge can never be equal to human curiosity; for this latter goes beyond our means of information, nay even beyond the boldest of our con-

conjectures. A finite understanding cannot comprehend the infinite arrangements of omnipotence.

The principles which have been deduced, from the unwarranted data of the essence and the origin of things, have divided the speculative world in their opinions. Some insist upon the eternity of the spheres: others, that they have had a beginning. Some, that existence has come from chance; others, that it has proceeded from the operations of wisdom and of design. But for argument sake, let us suppose, that each of these hypotheses be admissible, that is, that neither of them imply a contradiction; and farther, that neither of them can be infallibly demonstrated by the mere principles of reason.* In this case, the question must be, which of them is the most credible? For the first of these opinions, there is little to be said, for even Aristotle, who was the great patron of it, and held that the world was a necessary emanation from God, as light is from the sun, doth afterwards fairly acknowledge, that the philosophers before him were of opinion, that the world had a beginning. Besides which, we have the concurrent testimony of Hindoos,

* Bishop Wilkins.

Hebrews, Persians, Egyptians, Phœnicians, Grecians and Romans, as well as that of the Druids of the Gauls, of Christians and of Mahomedans. As to the difficulty mentioned by Aristotle, drawn from the principle *ex nihilo, nihil fit*, which is true concerning terrestrial generations, it is of little weight. For if every thing is to be denied, which our reason cannot comprehend, we must then deny that any thing can be *self-existent*; it being altogether as difficult for us to conceive, how any thing should be of itself, as how any thing should be made out of nothing. But supposing both matter and motion to be eternal, yet it is not in the least credible, that *insensible* matter could be the author of all those wonders which we behold in the universe. Here then, indeed, an anima mundi might be allowed. But can this anima mundi be divested of perception and reason, or is it an intelligent being? We have just replied to this question. It must be intelligent. Matter and motion can neither originate themselves, nor be physically admitted as first principles. The origin of all, therefore, is from God, the alone eternal. The supreme and omnipotent Ruler παντοκράτωρ of the Greeks.

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The celestial fabrics which thus have issued from the hand of God, are glorious instances of his almighty power. In looking at them, the greatness of their distance, indeed, makes their convexity imperceptible; and their spherical bodies appear merely like plain circular surfaces. But conceiving them, as we must, to be exactly similar to our own, the proof of this orbicular form, may in a familiar instance be taken from the earth. For example, if we travel to a considerable distance either southward or northward, still new parts of the heavens are discovered, and seem to rise higher before us, while the parts behind us seem to sink down, and fall under the earth. Thus the *polar star*, if we travel northward, is raised higher to us; and if we travel southward, is lowered proportionably to us; for then a great part of the earth's convexity comes between it and us.* This shews clearly that the earth is round; and from consequent analogy proves, that the planetary worlds are round also. It is wonderful, you will say, that the heavens should have been so accurately and so extensively surveyed: and equally, if not more surprizing, that we should know almost as much of that

* Baxter.

system of worlds, as we do of our own transitory habitation; nay, that it shall be easier to arrange the myriads of the fixed stars, and to describe the motions of the planets, than it shall be to account for the simplest natures, in the chaos of terrestrial physics!

The doctrines of the vacuum, and of the dense medium of *Des Cartes*, however, have both been attacked;* and in their room, a substitution has been made, of an eminently elastic fluid, which fills the immense capacity of space. A fluid not altogether different from that which was conjectured by Newton, and of which we have above taken notice. In this fluid, it is said, the Creator disseminated, by an act of his will, innumerable spheres of different magnitudes. The greater, designed to rule the motions of the lesser, were made to occupy centres, and were commanded by the Most High, to revolve about their own axis; there they imprinted their motion on the surrounding fluid; and the smaller spheres, plunged in this fluid, and hitherto at rest, were carried by its motion around the central sphere respectively; by which their revolutions were to be directed. The central sphere, by its movement of rotation, rubbing with rapidity the infinitely elastic mole-

* Marivetz & Goussier.

molecules of the fluid, excited in it vibrations. These vibrations, propagated through space among the contiguous molecules, struck all the globes suspended in it, only on the parts of their surface that were turned towards the central sphere, from which they derived their motion. These solid surfaces sent back by repercussion, the vibrating molecules; and from this shock arose a general splendor. Thus the central moving globes became suns; and then matter received its motion; time its measure; light appeared; and nature sprung into being. But to render the hypothesis still more mathematically clear in the opinion of these learned theorists, nine propositions are laid down, as the grounds and foundation of it. 1. The sun turns round his own axis in a fluid eminently elastic. 2. The sun cannot turn on his own axis in this fluid, without communicating to it its motion, and without making it turn round with him. 3. The general fluid, in turning round the sun, carries along with it the planets, of which the sun becomes the director. 4. The velocities of the orbs of this fluid are not equal, at unequal distances from the sun, but diminish in proportion to their distances from the sun. 5. The motion imprinted on the fluid by the equator, is more rapid than that which

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is imprinted on the same fluid by any other of the solar circles, taken between his equator and his poles: this greater velocity of the impelling fluid in the plane of the sun's equator, determining the planets to move towards that plane. 6. The planets do not follow the line of the greatest velocity of the fluid, because they receive latteral impressions: these impressions result from the vibrations of the æther towards the production of light; vibrations which the planets communicate by repercussion, one to another. 7. The planets, carried along with the general vortex, and intersecting obliquely, and twice in each of their revolutions, the plane of the sun's equator, must consequently describe ellipses about the sun, and therefore, pass at different distances. Of these distances, the least of all is called the perihelium, and the greatest the aphelium. The planets, in their perihelium, being plunged in orbs less distant from the sun, must receive from these orbs a greater velocity. 8. The vibrating motion of the æther to a state of light, acts more powerfully upon the planetary bodies than does the general orbicular motion, or circulation of that æther: this action is not equal, or the same, upon the different points of the enlightened hemisphere of the planet, because the hemisphere is plunged in

in orbs unequally distant from the sun. 9. The larger a planet is, the more the action of light varies, on the oriental and occidental halves of the enlightened hemisphere of that planet.

In the branchings of this theory, as in those of others, there is much ingenuity. But how infinitely wide of certainty is all such reasoning. Conjecture, however, in some respects may be allowable. Thus Newton supposed the sun and fixed stars to be great earths vehemently hot; whose heat is conserved by the greatness of their bodies, and the mutual action and re-action between them and the light which they emit; and whose parts are kept from fuming away, not only by their fixity, but also by the vast weight and density of the atmospheres incumbent on them, every way strongly compressing them; and condensing the vapours and exhalations which arise from them. To this, however, several obvious objections have been started. If the sun and fixed stars, it is said, be either in a state of real ignition, like that of a dense body, heated white hot, or of actual burning, they must be totally barren and uninhabitable: and to suppose this, of that infinite number of immense bodies, by far the largest of any we know

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in the universe, appears to be contrary to the design pursued in our globe, where every thing seems subservient to *animation*, and where every part is filled with life. On the contrary, say these philosophers, from the great fulgency and clearness of the sun's light, it appears to proceed rather from a flame or rarefied fluid vapour, than from a mere ignited dense body. A heated, dense, uninflammable body, though in fusion, emits light in so small a quantity, and that in so confused a manner, that it is of very little use towards vision. Whereas the flame of a candle, though it contains a quantity of heat, which may be considered as nothing in comparison to that of a large fire that does not flame, yields light regularly, and in much greater abundance. That the sun is not in a burning state, is probable, from its having continued many thousand years; long before the expiration of which, it is reasonable to suppose, either the whole of its inflammable matter would have been decomposed; or its atmosphere phlogisticated, so as to be no longer capable of maintaining that process. Neither is the combustion to be supposed to be slow and gentle, as in phosphorus. The light of the sun, probably proceeds from a luminous meteor in his atmosphere, surrounding his whole body at a distance;

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and which, therefore, illuminates both the sun himself, and the planets, and other objects without; and this is kept up by inflammable vapours, rising in sufficient quantity from the sun's body. The electrical fluid, for example, in an exhausted glass globe, shines, yet does not feel hot. It may possibly be so with the Aurora Borealis; at least, its heat does not seem to be considerable. Hence, therefore, as this latter phænomenon is sometimes very luminous, and extends itself over so great a portion of the sky, why may not the shining meteor round the sun be an Aurora, which differs from ours, only in being universal, continual, and much denser, and therefore, by far more bright and glorious? As the sun is the heaviest body of the system, and the centre of gravity, it may also be the centre of the luminous matter; and hence, it may abound much more in it, than it does in the planets. This admitted, the spots may also be supposed temporary holes, or discontinuities in the luminous meteor; and the temperature of the sun may be supposed so moderate, as to be favorable to the existence and propagation of organized and animated bodies. As in our earth, likewise, so it consequently may be supposed in the sun, there may be seas and dry land; woods and open plains; hill and dale; rain and fair weather;

ther; and as the light, so the season will be perpetual or diversified, only by distance, and occasional interstices in the luminous matter.

These, and such like ingenious deductions, we have already in some degree answered. We have considered the sun, on almost irrefragable grounds, to be the source of light and heat; we have acquiesced in the belief, that such light and heat are carried back in circulation; and we have consequently laid it down as a postulatum, that the exhaustion supposed from the rays constantly emitted, cannot be the fact, any more than that the blood thrown into the cheeks, can be the exhaustion of the blood of the animal heart. In regard to solar animation, compared with planetary animation; in this question there is evident difficulty. For to say nothing more, can we conceive a globe of integral light and heat, to be barely similar in its capacities to that of a globe opaque, and cherished only by a borrowed light and heat? The nucleous of the sun, I know it is said, is a solid opaque body.* The spots are generally held to consist of a nucleous or solid part, which appear much darker than the rest, and seem to be surrounded by a mist or smoke; and to be so

* Dr. Wilson.

so changeable in their situation and figure, as frequently to vary during the time of observation. Some of the largest of them, which are found to *exceed the bulk of the whole earth*, are often to be seen for three months together; and when they disappear, they are generally converted into *faculæ* or luminous spots, which appear much brighter than the rest of the sun. The opinion concerning these solar spots, is, that they are occasioned by the smoke and opaque matter thrown out by volcanos, or burning mountains of immense magnitude; and that when the eruption is nearly ended, and the smoke dissipated, the fierce flames are exposed, and appear like faculæ or luminous spots. * And it has been established from observation, that most, if not all the spots (seldom more than thirty of which are to be observed) are excavations in the luminous matter that environs the sun's body.

It was the opinion of Newton, that *comets*, or wandering planets, of which we have not yet spoken, sometimes might fall into the sun. Thus the comet of 1680 approached so near, that at its perihelium, or nearest position to the sun, it was not more distant from the sun than

* Bonnycastle.

than a 16th part of his diameter; and consequently, if it returns in 2255, it may fall into it.* To this, I shall say nothing; at the same time, that the dashing in of planets seems to be as inconceivable as the dashing out of planets. Neither one nor the other, however boldly assumed, is comprehensible. That appearances in the sun, or in the planets may have arisen from revolutions, in some respect similar to those which this earth has experienced, is from analogy readily to be granted. Mountains have been observed in the moon; mountains have been observed in Venus, which have been judged larger that those in the moon, though she does not appear to be furnished with seas; Mercury, likewise, has been observed to be a rugged mass, with more considerable excavations perhaps than in any other planet. The surface of our earth, indeed, has been for a certain length of time, in a state of comparative, though not of universal, tranquility. Our lands, our seas, our mountains, have in general kept their situation, at least we may say so for these last 4000 years. But can we say the same has been always the situation of the planets? This is undoubtedly impossible for us. But we may conjecture that revolutions have taken place

* Buffon.

place within them, and even without them. For instance, even as belonging to the system ourselves, when we consider the motion of those vagrant worlds, the comets, and reflect on the laws of gravity, how dreadful might we not suppose the accidents might be to this globe, were one of them to come too near us. By a comet, an almost universal aqueous deluge might be occasioned; or we might be destroyed by a deluge of fire. Reduced to ashes; turned from our orbit; the moon drawn from us; or what would be worse, we ourselves carried away beyond the regions of Saturn; and there made to perish in a cold insupportable by man or beast.* The approximation of the comet of 1680, as near to our earth as it was to the sun, would immediately have caused an evaporation of all the waters of our ocean; and consequently its bed would have been dried up, and we and all other organized bodies would have perished, from the want of the essential circulation of humidity. The celestial bodies have unquestionably, in some instances, the appearance of having been deranged. But can we establish their derangement on such conjectural premises? or shall we, disregarding them,

* Lambert.

adopt other, not less fanciful interferences? As for instance, that a comet not so large as that of 1680, but of a mass of a much inferior size to that of the earth, should, by approaching too near it, be forced to remain with it, and to perform its revolution around it; that this is the history of our moon, as well as the history of the satellites of Jupiter and Saturn; since in the heavens, as on the earth, the weak receive law from the strong?

But this translation of comets into satellites, and any other of the conjectural effects producible from them, are all so theoretical, and so singular and hazardous in the supposition, that we may with the same lack of ceremony, with-hold our belief from them, that we have from the other fanciful solar and planetary hypotheses. At the same time, as we are well convinced that all is made with design, that all is linked, and that the universe is in the aggregate, a manifestation of the attributes of God; so we must believe, that the mighty globes which perform their revolutions in space, are filled with life. In so perfect a work, we cannot admit of voids. With respect to the earth, is it not replete with beings and with motion; and is not nature every where occupied

pied in fecundating, in organizing, and in drawing forth existence? In a particle of substance, in a drop of water, are there not myriads of inhabitants? And shall we suppose that the vast bodies, which like ourselves, roll about their suns; and who like us, receive their light and vital heat, that they shall be empty and unpeopled? Vain as we are, our knowledge is but limited. How can we doubt then, that the heavenly bodies are inhabited? Do we know the full extent of our own animation? No, not the moiety of it. From the elephant, indeed, we can trace life, down to the mite; but this mite is an elephant to another series of organized beings. A small insect, that is resident on this, and another that is resident on that side of a leaf, have as little communication, and are as little known to each other, as we are to the people of the Georgium Sidus.

The moon, however, being the nearest orb to us, and consequently the most open to our inspection, we can easily discern, that her surface is not smooth or even, but that it is diversified with hills and vales, continents and seas, and variety of mountains. The lunar regions, have even proper names assigned to them. Sir Isaac Newton mentions the atmosphere of the

moon, but other astronomers doubt of this atmosphere. For my part, I cannot but suppose there is an atmosphere, not only around the moon, but around every one of the planets, unless they are to be imagined globes of adamant, or something still more hard.* Every thing about our earth is in constant change: I am not certain, if we can except any species of bodies that can be named. Metals themselves seem gradually to decay, as well as to come to a state of maturity. Every thing, therefore, contributes its share to the atmosphere. Thus, unless we would suppose that matter in the planets is not acted upon in the same manner as matter in our earth, (which would be a supposition without foundation, and contrary to reason), we must conceive, they have atmospheres about them, similar to that which is around us. Wherever there is heat and moisture, there must be evaporation, and consequently an atmosphere. Nay, wherever there is cold, there must be an atmosphere; for vapours are observed to rise plentifully in the hardest frost. Moreover, the late discovery of volcanos in the moon by Herschel, is a proof that the matter of which the moon is composed, is similar to that of our earth; and if possible, establishes beyond

* Matho.

beyond a boubt, the existence of a lunar atmosphere.

But we are not to insist upon an exact similitude between the planets and the earth. Whether there be herbs, or plants, or animals, says Galilæo, like ours, growing in the moon, or any other planet; or whether there be any rain, or wind, or lightning, produced there, as there is upon earth, I neither know, nor can conceive; much less, that there are men dwelling there. But however, I do not see how it necessarily follows, that because there grows nothing there, like any of the things here, therefore, there can be no alteration made there; nor any things generated and dissolved, which are not only different from ours, but such as we cannot have the least notion of. For as I do not doubt, but that if a person were born and brought up in a large wood, among wild beasts and birds, and had never known any thing of the element of water, it would never have entered into his imagination to think, there was in nature, a world different from the land; full of animals, which could move swiftly without legs or wings; and that not on the superficies only, as beasts do upon the ground, but at the very bottom of all; and not only so, but that they can stand still in any place, which

is more than a bird can do in the air. Nay further, that men dwell there, and build large palaces; and that they have so quick a method of travelling, that they can, without any trouble, remove their whole families and houses into the most distant countries. A person, I say, such as this, continues Galilæo, would never think of the ocean of fishes, of ships, and fleets. So in the moon, there may exist some beings, who having no resemblance to us, can in no wise enter into our thoughts.

This reasoning is pure, and is stamped with the integrity of unpresuming genius. But although we acquiesce in the supposition that the planets are inhabited, is it not difficult, it will be said, to conceive how the comets can be peopled, which pass from the extremity of heat to the extremity of cold? The comet which appeared in 1759, and which returned the quickest of any that we have an account,* had a *winter of* 70 *years*. As to its heat, this surpassed imagination. With us, a body is susceptible of only a certain degree of heat. Iron made red, and still continued in a violent fire, only vitrifies and turns to cinder. If therefore, the comet of 1680, according to Newton, was

* Lambert.

was two thousand times hotter than red hot iron, its composition must be totally different from that of any substance known to man. And yet, can it be conceived that such mighty masses should be formed for nothing? Where, I repeat, is the necessity that all living beings should be like us? Is it not more reasonable to suppose, that different organizations, different forms, are calculated for different worlds? To suppose otherwise, is it not to adopt the prejudice which led the ancients to deny, that the torrid and the frigid zones were habitable? Even the pure element of fire, for ought we know to the contrary, may have its population, may have its appropriate inhabitants. But, indeed, we are lost, when we attempt to reflect upon this extraordinary class of the planets. For instance, the comet which appeared from the 22d December, 1680, to the 18th of March, 1681, had then appeared only four times. The first, in the September which followed the death of Julius Cæsar, forty three years before Christ. The second, in the 531st year of Christ. The third, in the year of Christ 1106. And the fourth, in the year 1680. What a prodigious period, in the performance of its revolutions!

These wandering planets, little as we think of them in general, are yet of greater moment perhaps in the scale of creation, than either we ourselves, or any of the few other globes that have been discovered to appertain to the solar system. Their numbers, indeed, are alone sufficient to indicate their importance. They greatly exceed the planets. The precise number of those belonging to our system is unknown. It is said, that more than four hundred and fifty had been seen previous to 1771. Those, however, whose orbits have been sufficiently and accurately settled, so as that we can ascertain their identity when they shall appear again, amount to about fifty nine, reckoning as late as the year 1781.* But there yet may be thousands. How glorious then to form an idea of these travelling worlds, peopled as it were with observers, employed in the contemplation of the universe at large, as we are in the contemplation of an insignificant atom of it: passing from one sun to another: observing the orbits of the celestial spheres: viewing their particular, as well as their general revolutions: over their heads, thousands of years rolling, merely as thousands of days over ours. But the

* Bonnycastle.

the flight is too sublime for circumscribed capacities. It is enough, that if as on our little earth, we can trace the works of a bounteous Providence, so we can in the heavens grasp in demonstration, the wonders of his omnipotence. Can a blind fatality have originated such harmony; or could effects so transcendant have proceeded from non-intelligence and necessity? Miserable absurdity, humiliating instance of imbecility and ingratitude!

LETTER

LETTER XLIX.

ASTRONOMY is said to have been the daughter of idleness; as geometry was of interest; and poetry of love. But the assertion is not well grounded. Astronomy is not merely a speculative science: its use is as extensive as its researches are profound. To it, navigation owes its safety; to it, commerce is indebted for its extension; and geography for its improvement. But, what above all, speaks its praise, is, that it has led the way to the diffusion of knowledge, and to the civilization of mankind. Thus then we may be allowed to consider the science of astronomy as the most sublime, the most interesting, and the most useful, that has at any time employed the faculties or engaged the attention of man. How high it lifts the mind above the low, contracted prejudices of the vulgar; how clearly does it convince the understanding; and how indelibly stamp the conviction of the existence, the wisdom, the goodness, and the superintendancy of a Supreme Being! Can any thing, therefore, raise the glory of the human

species

species more, than to see a little creature, inhabiting a small spot amid innumerable worlds, taking a survey of the universe; comprehending its arrangement; and entering into the scheme of that wonderful connexion and correspondence of things, so remote, and which the exertions of a God, alone, could have established?

This science was known to the ancients; but to what extent or accuracy, their opinions are too broken and obscure, to afford full information. What Ptolemy relates of the observations of the heavens, by which Hipparchus reformed astronomy two thousand years ago, proves, indeed, that in the most remote periods, this science was studied. In particular, it was highly cultivated by the Chaldæans. From Babylonia it passed into Egypt; soon after it was carried into Phœnicia; and thence it was translated into Greece by Thales, who was the first of that nation who could calculate an eclipse. But the Greeks derived their purest knowledge of astronomy from the Pythagoreans, who asserted, that the earth and the planets moved round the sun, which was at rest in the centre of the system. It is also said, that the Greeks improved their knowledge in astronomy, from con-

conversing with the Druids, who, according to Julius Cæsar, instructed their pupils in the science of the stars, and the magnitude of the heavenly bodies. From the Greeks, the Romans imbibed their information on the subject of the planetary worlds. And from these different fountains, chiefly through the channels of Arabia, did astronomical science pass into Europe. The old astronomy, supposed the earth fixed and quiescent in the centre, and that the heavenly bodies performed their revolutions round it. The new astronomy, or the Copernican, supposed the sun at rest in the centre, and the planets, with the earth, to move in ellipses round him.

The system of Copernicus, which he published about the year 1500, and which undoubtedly is the most simple, the most conformable to observation, and the most adequate to the explanation of the planetary phænomena, we thus see, is so far from being of even recent date, that it was in some respects, though perhaps not correctly, taught by Pythagoras, Aristarchus, and many others. Diogenes Laertius, and Plutarch, have transmitted to us their doctrine on this subject. The latter, speaking of the opinion of Timœus the Locrian, says,

says, that by holding the different planets to be animated, Timœus meant nothing more than that the sun, the moon, and the other planets, served for the mensuration of time, by their revolutions; and that the earth should not be imagined to be always stationary, but to have a circular motion, as since taught by Aristarchus of Samos, and Seleucus. An hoc modo moveri statuebat terram, quo solem, lunam, & quinque planetas, quos conversionum causâ appellat instrumenta temporis. Et oportuit terram devinctam circa axem universi, non ita fabricatam intelligi, ut uno contenta loco maneret, sed quæ converteretur & circumageretur. Post modo Aristarchus & Seleucus ostenderunt. Aristarchus lived about 300 years before Christ.* The astronomers of our days, indeed, have carried their discoveries into the regions of the stars, and know the planetary system, better than Hipparchus, Ptolemy, or any others of the ancients. But some of the sublimest truths relative to this celestial science, (and which have not been firmly established among us for more than three centuries) were unquestionably known to several nations of antiquity. Their demonstrations have not come down to us; they have been lost. But, if in those

* Duten. Recherches.

those writings which have escaped the injuries of time, we find variety of instances of the splendor and profundity of their meditations, we cannot but believe that some of the learned of those nations took the same pains, and might have been perhaps not much less successful than the moderns, in their speculations on astronomy. And this conjecture is strengthened by many of the titles that are preserved, of works which have perished.

With what people astronomical researches commenced, it would be vain to inquire. It has been said, astronomy has been known from the beginning of the world. But this, by saying too much, says little to the purpose. As a science, it unquestionably is of ancient date. Nor would it be perhaps adventuring too far, were we to suppose it to have been known to those portions of the earth, to those lost people, whom we have supposed to have been submerged, when the present face of things was drawn into existence. All the various titles, says Bryant, that we find in the heathen mythology, we at last find comprized in Apollo, or the Sun. Hence his Priest was styled *Purcon*. Dionusus, Bacchus, however denominated, all related ultimately to the Sun. And hence, Selden remarks,

marks, sit Osiris, sit Omphis, Nilus, Siris, sive quodcunque aliud ab Hierophantis usurpatum nomen, ad unum tandem solem, antiquissimum gentium numen, redeunt omnia. *Hippa* was anciently a title of Apollo, and was sometimes expressed in the masculine gender Ιππος. Pausanias takes notice of a curious and remarkable piece of antiquity, though he almost destroys its meaning, by referring it to a horse. It stood near Mount Taygetus, in Laconia, and was called the Monument of Hippos. The Author tells us, that at particular distances from this Monument, stood seven pillars, κατα τροπον οιμαι αρχαιον, placed, says he, as I imagine, according to some ancient rule or method; which pillars were supposed to represent the seven planets. This, however rude, remarks Bryant (but here Bryant himself is in an error), is certainly the most antient representation upon record, and consequently the most curious of the planetary system.

To the Chaldæans, as to the first astronomers, we are directed to look by historians in general, both sacred and prophane. But properly speaking, there was no such nation as the Chaldæans; nor any such kingdom as Chaldæa. They are mentioned in the scriptures, by

by the word *Chas-dim*, that is, the men of Chas, *Scythians*, or wanderers, who had entered into Assyria and Egypt long before the Prophet Jeremiah. Chaldæa was nothing more than a small territory, south of Babylon, appropriated to the Chaldæes. And there they instructed the Babylonish priests in the art of Chaldæa, or of predicting the revolution of the heavenly bodies. Chaldæi appears to be the general name for the calculators of time, for soothsayers, and for magi, as is to be proved from *Laertius*. The Persians called those magi, says Dion. Chrysost: who were employed in the service of their Gods; but the Greeks being ignorant of the meaning of the word, applied it to such as were skilled in magic, a science unknown to the Persians. From the Magogian Scythians the name descended with the Pelasgi among the Celto-Scythiac nations, and hence, the present Scottish name *Culdea*.* But the Chaldæan philosophy was not taught after the Grecian manner, by public professors, to all sorts of auditors indifferently. It was restrained to certain families. These addicted themselves wholly to study, and lived exempt from all public concerns and duties. These were the Priests whom the Babylonians called Chaldæans.† In Babylonia,

* Collect. de Reb. Hib. † Diodorus Siculus.

lonia, says Strabo, there were peculiar habitations allotted for the philosophers of that country, who were termed Chaldæans. They inhabited a certain portion of Babylonia, adjoining to the Arabians, and to the Persian gulph. These were the order, who went out with others to meet Alexander. "Then went the magi, after "their manner; next went the Chaldæans, non "vates modo, sed artifices Babyloniorum," whom Curtius interprets, not those who made instruments for the practice of their art, but the Chaldæans of both sorts, the tradesmen and the learned. Moreover, as all the professors of learning among the Chaldæans, were distinguished from the rest of the people by their common denomination, so were they distinguished among themselves into sects, denominated from the several parts of the country wherein they were established, and according to the several sciences which they professed. *

Though astronomy was in high esteem among the Chaldæans, and they cultivated it with great diligence, it does not appear to the conviction of some modern writers, at least, that they made any very considerable progress in it;

* Strabo. Pliny.

nor, indeed, could they, say they, comparatively speaking, when we recollect they were destitute of the instruments invented and improved in later times, as well probably, as of the geometrical and arithmetical operations now familiar to every astronomer. In the time of Alexander the Great, these philosophers wished it to be believed, that astronomy had flourished in Babylonia four hundred and seventy thousand years. But this was the effect of preposterous vanity; and though Cicero mentions the observations of such a wonderful period, it yet might be somewhat nearer the truth, if we were to reverse the order of things, and to turn these years into days. Callisthenes, who accompanied Alexander, sent an account of the observations he had met with, to Aristotle: these observations went no further back than one thousand nine hundred and three years. They remounted twenty two hundred and thirty four years beyond the christian computation. Notwithstanding which, the Chaldæans had indisputably great astronomical merit; and whatever was the antiquity of their knowledge, they were at least the instructors of those who have hitherto been called, ancient astronomers. Pythagoras, who flourished near 600 years before Christ, and who established true philosophy, nearly at the

the same moment that true liberty and the consulship became established by the elder Brutus, acquired his knowledge of astronomy in the east, and in other foreign countries. He spent 22 years in Egypt, and complied with all the customs peculiar to the priesthood, the better to obtain an unrestrained intercourse with those from whom he was to derive instruction.*

Modern astronomers claim the merit of having found out the principles of universal gravitation, and of the centripetal and centrifugal forces. But it is certain the ancients were not ignorant of those powers. Pythagoras, evidently alludes to the centrifugal, and to the contrary centripetal impulse, in that passage which he concludes by saying, that God is κυκλων απάντων κίνησις, the motion or mover of all circles.† The moderns, indeed, have explained them with more clearness and precision. Not that the ancients gave them expressly the names which they have at this day. They clearly, however, understood the laws of the motions of the planets, according to their distance from a common centre. Plutarch, who was acquainted

* Jamblicus. † Baxter.

with almost all the brilliant truths of astronomy, and the attractive forces which make the planets gravitate towards each other, attempts to account for the principle of attraction, by saying, "there is a reciprocal attraction between all "bodies, which is the cause that the earth "makes all terrestrial bodies gravitate towards "her, in like manner as the sun and moon "make all solar and lunar bodies gravitate to-"wards them; and these are retained in their re-"spective spheres by the sole power of attrac-"tion." But others, particularly Pythagoras, were unquestionably masters of this doctrine long before Plutarch.* The Pythagoreans, says Aristotle, held that the earth was moveable, not seated in the midst of the universe, but suspended as being one of the stars; that it was carried about the fire which is in the centre; and that it thereby made night and day. This was what their master taught. Numa, remarks Newton, would not have constructed a temple to Vesta at Rome, nor placed in it a perpetual fire, had it not been as a symbol of the immobility of the sun in the centre of the world.

But it would be endless to dive into all the numerous authorities which might be adduced, of

* Duten.

of the astronomical knowledge of the ancients. We will not unnecessarily multiply quotations, and the more especially, as we must recur to the subject hereafter. What has been summed up by the most able inquirers, will be sufficient. Sir Isaac Newton's veneration for the ancients was great: his opinion of them was, that they were men of great genius, and of superior minds; who had carried their discoveries (particularly in astronomy, and in other parts of the mathematics) much farther than now appears from what remains of their writings; for more of those writings have been lost, than is preserved; and perhaps new discoveries are not equal to the old losses. The followers of Orpheus held every star to be a world; the Pythagoreans held the same. Thales, and Anaximander, held the stars to be fiery, yet of a terreous substance; and the sun to be terreous also: they held the moon to be of the same nature with the sun, but to be illuminated by him.* Anaxagoras concluded also, that the moon was opaque, but enlightened by the sun; and that it was habitable, having plains, hills and waters on its surface. All the ancients, indeed, looked upon the moon as a planet that had no proper light of her own, but that she shone with

* Plutarch.

the borrowed light of the sun. But Orpheus is said to have been the earliest author who looked upon the moon as inhabited. His opinion is thus given.*

Struxit autem aliam terram immensam, quam selenem
Immortales vocant: homines autem, lunam,
Quæ multos montes habet, multas urbes, multas domos.

The spots in the moon, were imagined by Democritus to be nothing else than shadows, formed by the excessive height of the mountains which he believed to be in the moon, and which intercepted the passage of the rays of light. Plurarch goes farther, and conjectures that the moon must have seas and profound caverns, which not being capable of reflecting the light so strongly as the more opaque parts of the planet, the rays of the sun being absorbed by them, those shadows or obscurities are thereby occasioned. Have the moderns gone very much farther than this, even with the aid of their telescopes? Nay, what is still more worthy of remark, the opinion of a plurality of worlds was maintained by this philosopher, as well as by the generality of the Grecian sects. Heraclitus, and all the Pythagoreans,

* Proclus.

goreans, were also of opinion, that each fixed star was the sun of a system, which had planets and other attendants like the attendants of our own system.*

It has been said, we should infinitely respect that great man *Des Cartes*, the greatest perhaps among those whose names are written in the annals of science: he who drew more from his own proper fund, and whose powerful genius was less indebted to foreign scccours. The lights which have spread since the instant he illumined the torch of science, say his admirers; the knowledge which has accumulated from the rout pointed out by him to be followed; these should be considered as the immortal monuments of his glory. But his system has been rudely shattered under the immense edifice, of which it may be fairly said to have laid the first and corner stone. † But is not this panegyric in some degree too poetical? Is it quite consonant to matter of fact, that to his own proper funds, Des Cartes was solely indebted for the sublimity of his speculations? Or can it be altogether admitted, that he laid the corner stone of the edifice, in the contem-

* Duten. † Physique du Monde.

plation of which we are at present engaged? Pythagoras was no puny geometer;—nor was Anaxagoras an ordinary mathematician. The world is animated, says Thales, and God diffused through every part, is the soul thereof; the moving virtue, which penetrates the element of waters.* Consequently in this world there is *no vacuum*. That which is filled and governed by a Providence, must be a plenum. The contrary can only be defended by such as maintain, that the universe is inanimate, and not governed by a Providence.†

The discoveries of modern genius are undoubtedly great, and must be thankfully acknowledged. But the ancients pointed out to us the road of science. To their researches we are indebted for the lights which have since guided us in our progress. The Greeks and the Egyptians, having probably dipped in the same source, not only were acquainted with the orbits of the planets, but they understood, and we are told, could calculate the return of comets.‡ Cometas in numero Stellarum errantium poni a Chaldæis, says Seneca. But Anaxagoras, of all the Grecian philosophers, was the clearest

* Diogenes Laertius. † Plutarch. ‡ Diodorus Siculus.

clearest on the subject. He looked upon comets as stars that had a regulated course round the sun; and which did not shew themselves but in certain parts of their orbits, and after a considerable time. The hour will come, says Seneca, when posterity will be astonished at our ignorance in such plain things; and that which is obscure to us at present, by the industry of our descendants, and by the course of ages, will be clear and evident, even to demonstration. A few years, continues he, divided between our studies and our passions, are inadequate to such sublime inquiries. The nature of the heavens is not to be learned in a day. Again, Democritus, long even before astronomy reaped any advantage from the improved science of optics, but seeing as it were, through the eye of reason, declared the *via lactea* to be an infinite number of small stars; and such they have of late years been discovered to be, first by Gallilæo, and next by Keplar. Epicurus, who flourished upwards of 300 years before Christ, taught, that the sun is a kind of fountain, into which flow from above, from beneath, and from every side, perpetual rivulets of light: for the seeds of heat and light, throughout the whole solar world, so flow into the sun, as that immediately, as from one fountain head, both heat and

light

light burst forth, and spread themselves in various directions.* At the same time that they admitted of this circulation, they also maintained, at least the Stoics did, that the fire of the sun was like those fires which are in the systems of animated creatures; that it preserved, nourished, increased, and sustained all things; that it caused all the productions of nature to sprout up and flourish, according to their several kinds; and that as one kind of living being was generated in the earth, another kind in the water, and another kind in the air; so it were absurd not to suppose, that in that part which was most fitted for generation, living creatures are generated;† and that the sun itself has its inhabitants.

As the ideas of the ancients in regard to the shape and figure of the planets, were in general correct, we are not to be surprized, that the opinion of the earth's being round, inhabited in all parts, and consequently having *antipodes*, whose feet were in a direction immediately opposed to ours, was one of the oldest doctrines taught by their philosophy. Plato, I know, is said to have been the first who made use of the word

* Diogenes Laertius. † Cicero.

word antipodes. Και πρωτος εν Φιλοσοφια ἀντιποδας ωνόμασε (Πλάτων). But Plato was very far from being the person with whom the opinion originated. It had a date as far back as that of the elementary principles of astronomy.

The artificial sphere, as it is delineated to us, was not the work of Greece. Diodorus says, it was the invention of Atlas, by whom we are to understand the Atlantians; and Newton supposed the Zodiac to relate to the Argonautic expedition; and asserted that Chiron was the inventor of the sphere for the use of the Argonauts. If the supposition, that the constellations of the Zodiac allude to the Argonautic expedition, be admitted, it may, nevertheless, be reasonably questioned, whether Chiron, or any other Grecian, invented the sphere: for the greatest part of the stars in the constellation Argo, and more especially Canopus, the brightest of them, were not visible in any part of Europe. Is it to be supposed then, that even the worst informed astronomer would delineate constellations to direct a maritime expedition, "the principal stars in "which could not be seen by the mariners, ei-"ther when they set out, or when they came "to the end of their voyage?"* Nor is it probable

* Rutherforth.

bable that the sphere originated in Egypt: for, although many of the figures may be supposed to be Egyptian hieroglyphics, yet those of the Zodiac are not conformable to the order in which the seasons succeed each other in Egypt. Aquarius, for instance, which denotes the heavy rains of a winter season, could not be Aquarius of Egypt, where the winter is the finest season of the year, and rain very rarely falls. The sphere then must have been from some country more conformable to the order of the constellations.

LET-

LETTER L.

NATIONS succeed one another in the career of discoveries and inquiries, and the last is always the most knowing. Systems of science are gradually formed: the globe itself is traversed by degrees, and the history of the intellectual powers of every age, when past, is an accession of knowledge to those who succeed. The Romans had the advantage of the knowledge of the Greeks; the Greeks, of the philosophy of the east: and every scholar of modern Europe is, in this sense, more learned than the most accomplished person that ever bore either of those celebrated names.* But is he on that account their superior? Or, are his acquirements the spontaneous gifts of nature, and not the fruitful harvest that he reaps of former culture and slowly progressive investigation? The sciences, such as geometry, astronomy, metaphysics and theology, were carried to an high degree of perfection by the Orientals. In the days of Homer, we can observe the celebrity in which they were held, by the reputation of their followers,

* Ferguson. Civ. Sec.

lowers, the Egyptians. But the conquest of Egypt by the Persians, and the fall of their colleges, and other seminaries of learning, proved almost destructive to Egyptian erudition. Still however, it did lift its head, and flourished again for some time in the Pythagorean schools of Italy; Pythagoras having visited Egypt before the Persian conquest. Those who went before him, such as Orpheus, Musæus, and Melampus, brought away nothing that is recorded to us, but a crude knowledge of music, and a mystical theology. Thales, indeed, who was likewise an earlier visitor of Egypt, furnished himself with a few elements of the mathematics, and took a superficial and inaccurate view of physiology.

Reason is the chief prerogative of man. But in abstraction, or in the combination of sublime truths, it arises in part from our own exertions, and is in part the fruits of others industry. There is a great distinction between the power of becoming any thing, and the actually being that thing. Capacity, and energy, are not synonymous. There is a perpetual progress in human nature. Nothing is at first, what it afterwards becomes. The philosophers of the ancients, thus reflecting, very confidently asserted

asserted a more perfect state of man than that in which he is at present placed. The doctrines of the Pythagorean school, supposed this state, and a subsequent fall. This life they considered as a scene of punishment and of probation; and the great business of it, the endeavour to regain the former and better state, which it had lost.* This I mention, to shew, that even the very early astronomers, whom we have mentioned, had their masters; and that consequently a science, which requires such an unbounded exertion of the finest faculties, could not have been otherwise, than of a great age at the very earliest recorded period of the Chaldæan philosophy.

The signs of the Zodiac, as well as many other parts of the artificial sphere, are of such remote antiquity, that they have admitted of various, and extravagant interpretations. The Zodiac, says Bryant, was nothing more than an assemblage of Egyptian hieroglyphics. Aries was a representation of Ammon: Taurus of Apis: Leo of Osiris: Virgo of Isis. They called the Zodiac, the great assembly, or senate of the twelve Gods, εν δωδεκατομοριᾳ Θεοι Βουλαιοι. The planets were esteemed lictors and attendants, who waited

* Plato.

waited upon the chief deity, the sun. Thus, continues he, Newton, from not having searched deep enough into the authors who could have instructed him, became like Sampson, shorn of his strength, and went out like another man. But is this antiquary, however firm he may feel himself, more rationally supported in his system, than the great modern astronomer was in his explanation? The sun in its universal powers, was unquestionably the object which gave rise to these significant hieroglyphics. Yet still they are of disputable import, unless, indeed, they are to be received as the symbolical representations, or some such elucidation of the labours of Hercules, as conjectured from the fragment of Sancontiaho, preserved to us by Eusebius.

Astronomy had been cultivated for ages, before it gave birth to the mythology which consecrated its pursuits. The establishment of this worship, must have been of early date. It probably must have been, says an ingenious writer,* at the times in which the *bull* possessed the vernal equinox, and the *lion* the summer solstice; that is to say, about 2500 years before our vulgar æra. At this period, every thing

* De Septchenes.

thing wore a new face. The symbols of the sphere preserved their primitive signification; but they now assumed a character much more august. They were translated into the sacred language, and the aspects of the celestial bodies, gave occasion to those fables and those singular adventures, which poetry afterwards embellished with all the charms of fancy and fiction. The stars were worshipped as so many divinities, or rather, the intelligence that directed them, and which was considered as an emanation from the great soul of the universe. But, as I have already said, we must learn from others, before we reason ourselves. The mind must be deeply impregnated with the celestial dew of knowledge, before the soil can be quickened into vegetation and life. Genius may, indeed, anticipate the season of maturity; but memory must be exercised, before the powers of reason and fancy can be expanded; nor can the artist hope to equal or surpass, till he has learnt to imitate the works of his predecessors.*

The sciences neither had, nor could have had, in the ordinary course of things, a stated beginning at any period of time, nor in any par-

* Gibbon.

ticular place. They began at different periods, in different places, and were subject to all the revolutions that attend the human state. They were the growth of some countries; they were propagated into others. In some countries they flourished; in others they languished, and were soon at an end. They throve more or less, they lived and died, according to the characters of the people, and the fortune of their governments.* Through the obscurity of ages, however, we may catch a few rays of light, that faintly glimmer. Present knowledge is too apt to despise the dawnings of invention; not considering that all scientific ability is progressive, and that what may appear as insignificant, was the first necessary link to a new chain of improvement and investigation. In early periods, as in youth, indeed, the powers of imagination are most vigorous and predominant; those of the judgment ripen more slowly, and often attain not to their maturity, till the imagination begins to decline. On this account, it is of use to attend to the tenets of the old philosophers. The great varieties of opinion which have daily succeeded one another, have merely been raked from the ruins of antiquity. To the first owners, at least to the first acknowledged pos-

* Bolingbroke.

possessors; it is right to assign the credit of intellectual capacity. Thales was the first of the Greeks, who made disquisitions upon nature,* and he was born when Ancus Martius, the fourth King of Rome, began to reign. But Thales was preceded by others; for he found his masters in Egypt; and was indebted for his acquirements to the learning of the East.

The materials of science are more abundantly to be traced in rude and uncultivated periods, than in ages of civilized society. Thus among the Greeks, in the morning of their history, we find, that as poetry personified every thing, so their philosophy animated every thing. The elements, and all the corporeal parts of nature, became vivified, and inferior divinities filled and actuated the whole. The sublime ideas which sprang from this species of devotion, wound up the mind to enthusiasm, and to picturesque embellishment. With the spheres of the heavens, the daily rapid and regular motion of our own system attracted their regard; and they attributed to the stars a supernatural power, and were constrained by admiration, to pay them divine honors. They were looked upon

* Diogenes Laertius. Strabo.

by some, as inhabited by beings who not only guided their motions, but directed their benign or pernicious influence; and hence, they had adoration paid to them. Others imagined that the stars themselves were animated intelligences, or *zophesemin*,* and hence, to the sphere was paid the worship which was alone due to the Creator. To adore and enjoy the influence of these Deities, they assembled in the fields. Hence the name of *Temple*, which, in their language, signified the void of air, the space comprehended between the earth and the firmament. And hence, that they might design the object of their adoration, they made use of the word Θεω, which originally signified, the mere action of turning, or running; and which has since been ennobled with the Being to whom it was applied.†

Man is, by nature, curious and aspiring; fond of what is abstruse, and apt to despise things that are plain and easy, merely because they are so. The further objects lie removed from the pale of human knowledge, the more strongly they engage our attention, and excite our ambitious researches. But in endeavouring to soar too high in search of light, we are unfor-

* Sanconiatho. † De Septchenes.

fortunately apt to lose ourselves amid the clouds of error and illusion. At first, the celestial canopy was divided into three principal parts: that in the middle, called the Zodiac, contained the planes of the orbits, which the sun and planets describe. This zone was bounded on each side by two great regions, one on the south, the other on the north. The stars were next reduced to classes, and groupes were composed, which under the name of constellations, received each a particular form and denomination. Thus the firmament was peopled with men, with animals, and beings of every kind. These signs, which now seem so uncouth, were not, however, the children of unsystematic fancy: they signified the state of the earth in the different seasons of the year; they connected, as it were, the operations of husbandry with the celestial phænomena; and served at once as a rural calendar, and as an astronomical ephemeris.*

The celestial signs, as we have already observed, are not to be attributed to the Greeks, any more than the first rudiments of the sphere are to the Samoyeds and Laplanders;† or the twelve signs of the Zodiac to the emblematical

* De Septchenes. † Olaus Rudbeck.

representation of the twelve sons of Jacob.* They are of an age and country not accurately to be traced; but the probability is, that they are of Scythian origin. Among the signs of the Zodiac, there are some, that have, as it were, a common relation to every portion of the globe. Such are those that represent the course and effects of that Luminary which shines upon all; and of these, it is difficult to mistake the signification. Thus *Cancer* and *Capricornus*, that represent the boundaries of the sun's path, have always served to denote the solstices; *Libra*, which represents the equinox, is a very natural image of the equality of the days and nights; *Aries* and *Taurus* are well associated to the labours of rural life; and *Virgo*, with the stalk of corn in her hand, is evidently attached to agriculture; while *Sagittarius*, *Pisces*, and *Aquarius*, clearly allude to vicissitudes of climate; nor are *Gemini*, or the twins; *Leo*, or the vigour of vegetation; and *Scorpio*, or pestiferous blights, to be better disposed of, than in associating them to the like various purposes. The splendid magnificence of the sun, and the inestimable advantages derived from his influence, originally roused in contemplative minds, a species of adoration. But, men not only worshipped the Luminary itself, but

* Ac. de Bel. Lett. Tom 5.

but the infinite power which informs the whole of matter; which gave it impulse, and which sustains the heavens, the earth, and all the planetary glory.

It is asserted, indeed, I know, by many, and especially by a man of great eminence, M. Montucla, that the most ancient perhaps of any, the Hindoo division of the Zodiac, was borrowed from the Arabs or Greeks. But in this, as has been remarked by a learned Orientalist,* he is not quite correct. On the contrary, we have every reason to conclude, that both Greeks and Hindoos received it from an *older* nation, who first gave names to the luminaries of heaven, and from whom both Greeks and Hindoos, as their similarity in language and religion fully evinces, had a common descent. And accordingly we find, that the names of the Zodiacal stars occur even in the *Vedes*, which from internal, as well as external evidence, must be incontestably more than *three thousand years old*.†

To the observance of man, the sun always moves westward: he is but rising in the east to some, while he is already setting in the west to

* Sir Wm. Jones. † Asiatic Researches.

others: and it is twelve o'clock to some part or other of the earth, all the four and twenty hours round. This universal and never wearied operation of celestial influence, caused the sun to be adored under various names; and to be represented by various symbols. Thus the *Serpent*, because it every year changes its skin, recalled the idea of the sun, who is annually restored to new life, and whose oblique course is not unaptly represented by the wreathings of a snake.* And thus, as his heat penetrates all bodies, vivifies and developes the germs, and as he is, in short, the source and the principle of fecundity, he was invoked under the emblem of the *Phallus*, which in its origin offered nothing offensive to modesty or decorum. In the same hieroglyphic method of representation, the horizon was personified under the name of Mercury. The *Phenix*, so famous for its longevity and miraculous death, was at first nothing but the symbol of the Cycles, that succeed and grow out of one another. And *Argus*, that monster with his hundred eyes, of which one half remained open, while the other half remained shut, represented nothing more than the situation of the firmament; or one hemisphere enlightened,

* Macrobius.

lightened, while the other was in obscurity. But the emblems employed to express the various appearances in nature; to signify the planets; and to represent the glories of the ætherial world, were innumerable. The Muses, however, and the Fates, were given to preside over the harmony of the spheres, and the regularity of their revolutions.

These scientific phantasies, therefore, must have been the slow growth of time. Before an imaginary fabric is reared, we must have the advantage both of method and of materials. The strongest glasses cannot magnify, where there is not an object for optical experiment. In the progressive stages of knowledge, facts and principles must first be ascertained; judgment is only forced upon us by experience. Much must be investigated before systems can be erected. From comparative ideas, alone, can result just discrimination. The attainments of the parent, do not descend in the blood of his children; nor is the progress of man to be considered, as a physical mutation of the species.* Every man, however, at any given period, is too liable to imagine his ideas and his notions

* Ferguson.

notions to be his own; but almost every man in this case deceives himself. Bred to think, as well as to speak by rote, we furnish our minds, as we furnish our houses, with the fancies of others, and according to the mode and age of our country. We pick up our ideas and notions, in common conversations, or in schools.* It was in this manner, as we have seen, that the Greeks acquired, but did not originate, the learning which has been handed down to us as theirs. Pythagoras, for instance, pursued the discoveries of Thales in astronomy, whose propositions of geometry, were afterwards, among those of other ancient mathematicians, collected by Euclid.† From the same source, and from the Egyptians, he learned to divide the heavens into five zones; to understand the equinoxes and solstices; to observe, and nearly to predict eclipses; and to give to the year the number of 365 days.

The Greeks, whose imaginations were alive to every species of ethusiasm, and who in scientific festivals exceeded every nation of antiquity, in a peculiar manner, attended to those which were instituted to astronomy. The most magnificent,

* Bolingbroke. † Proclus in Euclid.

nificent, and the most numerous, were those of the sun. Each season was celebrated with proper solemnity, and always with symbols relative to its arrival, whether at the solstices or at the equinoxes. In the spring, when he returned from the East, they celebrated the great Dionysia. At the summer solstice, the Athenians placed the feast of Hercules. At Rhodes, those children of the sun, as they styled themselves, worshipped their parent chiefly in the autumn. In winter, they wept his death. But the Lacedemonians, besides Adonis, who was so celebrated in all the countries of the earth, deplored the fatal lot of Hyacinthus, as an emblem of the year, which like a tender flower, fades and loses its lustre. But soon the light re-appeared, the God revivified, and his return to life was every where celebrated. Ancient nations announced it by their songs of triumph. Each person congratulated his neighbour, and presents, as at this day, were sent, as a signal of the renovation of the year. And thus, we see how regularly the sun was attended in his progress. In truth, there was no institution with which he was not connected. Apollo, or the Fountain of Light, was incessantly adored. And hence, adds Boulanger, at the return of each period, the Greeks

praised

praised or blessed the Divinity who preserves the universe; and that primitive simplicity which had fixed the number, the order, and the dignity of the festivals of the solar and lunar vicissitudes, was great and sublime.*

It is now time for us, however difficult, to quit this fascinating subject. Cicero justly says, Hæc studia adolescentiam alunt, senectutem oblectant, secundas res ornant, adversis perfugium ac solatium præbent, delectant domi, non impediunt foris, pernoctant nobiscum, peregrinantur, rusticantur. And Bacon, a no less eminent man, in his Treatise on the Advancement of Learning, says, "As for the placits of "ancient philosophers, as were those of Pytha-"goras, Philolaus, Xenophon, Anaxagoras, "Parmenides, Leucippus, Democritus, and "others, (which men use disdainfully to run "over) it will not be amiss to cast our eyes with "more reverence upon them. For although "Aristotle (after the manner of the race of "the Ottomans) thought he could not safely "reign, unless he made away with all his bre-"thren; yet, to those who seriously propound to "themselves, the inquisition and illustration "of

* L'Antiquitè Devoilèe.

"of truth, and not dominion or magistrality,
"it cannot but seem a matter of great profit,
"to see before them the *several opinions of*
"*several Authors*, touching the *nature of things*."

END OF VOLUME II.

MVSEVM
BRITAN
NICVM